State of California AIR RESOURCES BOARD Stationary Source Control Division

AIR MONITORING QUALITY ASSURANCE

VOLUME VI

QUALITY ASSURANCE IN THE TESTING OF STATIONARY SOURCES

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By:

Engineering Evaluation Branch

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QUALITY ASSURANCE IN THE TESTING OF STATIONARY SOURCES

by

Engineering Evaluation Branch Stationary Source Control Division

> State of Califronia AIR RESOURCES BOARD

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6.1 INTRODUCTION

The source testing of stationary sources of air pollution is carried out to determine the types and amounts of pollutants emitted by these sources. Information gathered from source tests is used for planning, issuing permits, evaluating control systems, updating emissions inventories, and enforcing emissions limitations. For these purposes, source test data must be reliable; that is, the test must yield data in which users will have confidence. This reliability is provided for in a program called quality assurance.

Quality assurance is concerned with all the activities that have an impact, no matter how remote, on test results. Many of these activities are part of programs of <u>quality control</u>, the basic line or routine functions designed and implemented to provide a quality product. To these functions, quality assurance adds procedures that promote, review, analyze, audit, and report on quality control. In short, one way of looking at quality assurance is to see it as quality control of quality control.

The policies and procedures for achieving quality assurance in the testing of stationary sources are the topics of this volume. These policies and procedures are designed to produce test data that meet four criteria:

- -- Complete;
- -- Representative of the source's emissions;
- -- Accurate (that is, as near as possible to actual); and
- -- Precise (the agreement of repeated measurements of the same quantity; other words used to describe a measurement's

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precision are repeatability, replicability, and reproducibility).

As used in source testing, the definitions of accurate and precise are derived from definitions used by systems engineers. According to these definitions, the meanings of the two words do not always overlap; that is, precise measurement techniques are not necessarily the same as accurate ones. An analogy that is sometimes made is of a cluster of shots in a target. If repeated shots form a tight pattern around the bull's-eye, the shooting is said to be accurate and precise. However, if repeated shots form a tight pattern in outer rings of the target, the shooting is said to be precise but not accurate. For more on the definitions of precise and accurate, the reader is invited to see the following: Environmental Protection Agency, Quality Assurance Handbook for Air Pollution Measurements, Volume I--Principles (Research Triangle Park, North Carolina: U.S. Environmental Protection Agency, 1976), pp. A17-A21; and E.J. Kovalcik, "Instrument and Measurement Errors," Test, April/May 1975, p. 10.

This volume has been designed to help program managers and source-test personnel gather data that meet the above criteria. Sections of the volume list measures and prerequisites planned to reduce the chance and magnitude of error. In addition, the volume prescribes steps to take to assure that the best possible results can be obtained with calibration gases, instruments, and other source-test equipment. Planning, auditing,

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and reporting on source tests are discussed, and appendices give specific methods for estimating the magnitude of errors, performing source tests, and maintaining and calibrating instruments.

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6.2 GENERAL FACTORS INVOLVED IN STATIONARY SOURCE TESTING

6.2.1 GENERAL COMMENTS

The purpose of any source test program is to determine the pollutant concentration being emitted from a source. By measuring the pollutant concentration and the stack gas flow rate, the pollutant mass emissions can be calculated. The reliability of the test results depends largely on whether these measurements and all associated calculations are performed correctly.

To assure that a series of measurements represent the source's emissions, the measurements must be taken in a manner that is dependent on the process operation. Obtaining representative measurements is difficult in many cases. The difficulty arises because control agencies typically test a large variety of stationary sources and because some control agencies do not have sufficient resources to perform enough tests on the same source so as to establish a large data base. In addition, variations in the source operation during testing in some cases add a large degree of variability to source test data. When key parameters of a source operation can be monitored, it is sometimes possible to explain variations in test data. However, when source variations cannot be monitored, it becomes a serious problem to determine whether variations are due to process changes or errors in sampling techniques. Standard test procedures, knowledge of the source operation, and experience gained from testing must be used to decide if test results are indeed representative of the actual emissions.

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6.2.2 ERRORS

The errors associated with source testing are generally described as <u>systematic</u> and <u>random</u> errors. A principal objective of a quality assurance program is to identify and reduce these errors.

Systematic errors are errors which can be reduced by the source test team. For example, systematic errors may result from:

- 1. Record keeping
- 2. System setup
- 3. Equipment maintenance and cleaning
- 4. Test personnel
- 5. Equipment calibration
- 6. Sample handling procedures

These sources of error, which are discussed further in later sections of this manual, can be reduced by the use of standard sampling and calibration procedures.

Random errors are more difficult to reduce. An example of an error is the uncertainty involved in reading an instrument. Repetitive readings of the same variable tend to decrease random errors. The significance of any one random error may be small, but a series of random errors may be substantial in the calculated result. There are a number of statistical techniques available to determine the cumulative effect of random errors in the final result. Appendix A contains guidelines for estimating the significance of random errors.

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6.3 TEST METHODS

Selection of the most appropriate method to be used for a specific test operation must take into consideration the chemical and physical properties of the gases to be tested. In addition, the types of analytical methods available for specific contaminants are also factors in determining the test method used. More specifically, the type of analytical method available may limit the test to integrated sampling, grab sampling, continuous sampling, or a combination of these. A look at problems associated with each method is presented here, and a description of the source test procedures themselves is given in Appendix B.

6.3.1 INTEGRATED SAMPLING

Integrated sampling can involve the passing of the exhaust gases through a filter, a chemical absorbing solution, water, or any combination of these throughout the test. The gas sample may also be collected in an evacuated container or pumped into a bag at a constant flow rate for the test duration. The filter, solution, and/or container contents are then analyzed in the laboratory. Use of this method results in average emissions being determined but cannot reveal any variations in emissions that may have occurred during the test. Almost all sampling for particulate matter is done by the integrated method.

To reduce the chances for error in obtaining a representative sample, the source test team must consider the isokinetic sampling rate and the probe location. (Isokinetic sampling adjusts the collection

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nozzle velocity to the same velocity as the stack to prevent alteration of flow streamlines).

Integrated sampling normally requires more handling of the test equipment, and the sample analyses techniques offer more opportunities for error than do most other methods. The use of a checklist will aid in reducing errors.

6.3.2 GRAB SAMPLING

A grab sample is a gaseous sample taken over a relatively short time period. Samples can be collected by (1) allowing the sample to fill an evacuated container, (2) inflating a flexible bag, (3) drawing the sample into a syringe, or (4) purging the air from a container with a gas sample. After collection, samples are taken to a laboratory for analysis.

Quality control problems associated with grab sampling are:

1. Contamination of container or bag. Assurances must be made that the material of the container does not react with the contaminant to be measured. Selection of the container material must be made considering the chemical properties and interactions with the stack gases. If containers are to be reused, they must be properly passivated with respect to the contaminant gas. A log of the types of samples collected in the container should be kept along with a record of passivation

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- Loss of concentration of sample due to condensation on container walls. An absorbing solution or a heated container are some methods of controlling this loss.
- Test results reflect only an instantaneous value.
 If the basic process has variations in emissions, many test samples may be required.

6.3.3 CONTINUOUS SAMPLING

Continuous sampling can be broken into two categories: extractive and in situ (in-stack) techniques.

Extractive sampling is the primary technique used by air pollution control agencies. It is accomplished by drawing a sample from the stack through a probe and a connecting line to electronic instruments that analyze the gases. Specific instruments must be approved by the responsible district. See Section 6.3.4 below for approval procedures. Variations in emissions and average emissions can be determine by this method.

Quality control problems associated with this technique are:

 Conditioning of the gases before passing through the measuring device. Care must be exercised to assure that conditioning does not change the concentration of the specific pollutant to be measured.

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- 2. Interference of components of the gas stream other than the specific pollutant to be measured. Interaction of pollutants while being measured must also be considered. Information can be obtained from the manufacturere of the instrument and/or by quality control testing in the laboratory.
- Accuracy of calibration gases and possible interaction of the carrier gas. Quality control of calibration gases is covered in another section of this manual.

In situ sampling instruments measure concentrations as the stack gases flow by sensors located in the stack. This is usually a permanent installation, is not normally used by enforcement agencies for source testing and will not be discussed in detail. Quality control of this equipment can be accomplished by doing comparison testing with other approved sampling methods on a periodic basis.

6.3.4 ALTERNATIVE METHODS

When testing to determine compliance with a regulation, the test method specified in the regulation must be used. Where no test method is specified, a test method adopted by the ARB or by the responsible district must be used. If no appropriate adopted method exists, then the test method used must be approved by the regulatory agency and must be thoroughly documented.

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If the organization performing the testing desires to use an alternative to the adopted test method, the organization must establish equivalence of the alternative test method in the following manner to the satisfaction of the responsible agency:

- Details of the alternative method must be submitted to the district for review and discussion.
- The laboratory analysis procedures must be described in the test method.
- 3. A minimum of three sets of parallel tests (with the adopted and the proposed alternative test method) must be performed on a single source type.
- If possible, two of the sets of parallel tests should be performed during different source operating conditions.

When applying for permission to use alternative test methods, the applicant shall provide the responsible agency with a list of appropriate uses for the test method including the source operating conditions during which the proposed test method would be used.

Equivalency for continuous analyzers used for source sampling may be established if the analyzer satisfies the following criteria.

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- Operational and performance specifications equal or exceed those listed in Table 1.
- The analyzer is capable of a 24-hour unadjusted continuous operation without the zero span or mean drift exceeding the limits specified in Table 1.
- The analyzer's response has been verified by the use of side by side comparison testing with an approved analyzer or adopted method.
- 4. The analyzer's response is not significantly affected by other species present in the gas stream. This must be verified by performing interference tests.

		Oxyge.i	Hy Jro- carbons	Carbon Dioxide	Carbon Honokide	Hydrogen Sulfide	Dxides of Nitrogen	Sul run Dioxide	
1/ Other types wil		Uses the paramagnetic properties of oxygen	Flame ionization method of detection	Non-dispersive infra-red absorption	Non-dispersive infra-red absorption	Photometric messurement of the chemilum- inescence from the reaction of of H ₂ S with ozon8	Photometric measurement of the chemilum- inescence from the reaction of NO with ozone	Photometric measurement of absorption of SDg radiation when subjected to ultraviolet light	Typical Principle of Operation 1/
also he arrentahle	2	$\begin{array}{l} 0 & -5.\% \\ 0 & -10.\% \\ -25\% \end{array}$	$\begin{array}{c} 0 \\ 0 \\ - \\ 100 \\ 0 \\ - \\ 1000 \\ 0 \\ - \\ 1000 \\ 0 \\ 0 \\ - \\ 100 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\$	0 G 1 1 538	0 - 1000 0 - 10,000	0 - 5; 0 - 12.5 0 - 125 0 - 500 0 - 1250 0 - 1250 0 - 5000	0 - 25 0 - 100 0 - 250 0 - 1000 0 - 2500	0 3000	Typical Range or Ranges PPM
		.01 %	1 to 2 ppm Methane	1% of instrument scale	. 10	- -	2	10	. Minimum Detectable Sensitivity PPM
		1+ 33 34	+ 	1+ 2 Q	اب عو اب	1+ 89	· ++] &?	+ 1% HT Range ± 2% Lo Range	Noise Level Scale (pea) to peak)
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		i+ 2,0	÷ 2,0	14	+ 2,0	0.57	* 2 _* 0	± 2.0	Calibration or Span Grift in Instrument After 24 Hours of Un- adjusted Contin- ous Obert. Change % of Full Sale
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		1+ 	!+ 	н Ц	а 	14 		14	Linearity Maximum Deviation Between any Two Bange Settings

types will also be accentable

ANALYZER SPECIFICATIONS FOR SOURCE SAMPLING

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6.4 PLANNING THE TEST PROGRAM

Planning of a test program, or even a single source test, must include all of the procedures and steps necessary to ensure that data obtained from the source tests will be accurate, precise, representative, and complete.

At the earliest opportunity, a pretest inspection of the source should be performed for the purpose of determining:

- The type of process or operation. (Obtain a flow diagram if available.)
- How the plant operating conditions are likely to affect emissions.
- 3. The types of emissions.
- Where the emission points are located, and if those points are accessible.
- If the existing platforms, sampling ports, and power supply outlets are satisfactory.
- The duct size, the temperature, pressure and velocity of the effluent gas stream, and an estimate of the moisture content of the effluent gases.
- The type of location and condition of process instrumentation.
- Safety hazards and special equipment required. (Obtain approval from appropriate safety officials if necessary.)

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The gathering of such information may be facilitated by using a standard form such as the ARB's Engineering Investigation Report (See Appendix C).

The plan for collecting the sample requires preliminary knowledge of the process and its operating characteristics. The sample or test is useful as it relates to the process. The sampling plan should include full information on process feed rate, fuel rate, and stack gas velocity and temperature. It is essential to determine in advance if the process is steady state or cyclic. It is also essential to make arrangements with operating personnel to hold the process at normal operating conditions for the duration of the test, to operate at rated capacity, or to operate as specified in the operating permit.

If the process is cyclic, the sampling period should be planned to span at least one complete cycle. If the cycle is of short duration, it may be necessary to sample over several cycles to obtain an adequate sample. Cycles of extended duration may be broken into definable parts. It is often desirable to study parts of a cycle because an average obtained during each part may be more useful than an average over the entire cycle.

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6.5 PREPARING FOR SOURCE SAMPLING

To minimize error care must be exercised in the preparation of the sampling trains and in the handling of samples.

6.5.1 GRAB SAMPLING

Two types of containers normally used for grab samples are flasks and flexible bags. Control must be exercised to assure that the containers are clean before use and that the sample will not deteriorate during transportation from the source to the laboratory.

6.5.1.1 Flexible Bags

Use only bags that are coated with Mylar, Tedlar, or other nonreactive material. No special preparation is required other than marking the bag for identification and assuring that the injection hole or valve does not leak. The best policy is to use a bag only once. However, it may be possible to reuse a bag for the same contaminant (with a separate log sheet for each bag). All bags should be purged several times with the sample gas before the sample is collected.

6.5.1.2 Flasks

Either glass or stainless steel flasks are used to prevent material reaction with the test sample. Glass flasks should be protected to prevent implosion or breakage. All flasks shall be thoroughly cleaned before use. Cleaning procedures are given in Appendix F.

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Deterioration of test samples in transportation can be prevented by using absorbing solutions. If absorbing chemicals are required, only fresh reagents may be used, and these should be prepared by qualified laboratory personnel. In addition to the test sample flasks, a flask containing the absorbing solution is set aside for analysis as a control ("blank").

It is recommended that the flasks be evacuated at the sampling site rather than at the laboratory. Record the volume of flask, the volume of reagent, and the temperature and pressure of the flask. Identify each flask with time, date, location of the sample source, and identity of the person who collected the sample.

6.5.2 INTEGRATED SAMPLING

6.5.2.1 Gaseous Samples

The flask or bag should be prepared as described in Section 6.5.1. Sampling probes should be cleaned as described in Appendix F. Connecting tubing should be a material that will not react with the contaminant to be sampled. If rubber is to be used as a connector, it should be visually inspected for cracking, or a leak check should be performed.

6.5.2.2 Particulate Matter Samples

Filters must be prepared according to the test procedure in Appendix B. All components must be thoroughly cleaned as described in Appendices B and F. Connecting tubing of various materials that do not

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interfere with particulate matter collection can be used. Care must be taken that no small particles are rubbed off when slipping the tubing onto the metal or glass connectors. Sharp edges on connectors should be filed, ground smooth, or fire polished to prevent this. Care must be exercised for glass to glass connections so that silicone-mating grease does not get into the sample train. It is suggested that grease not be used if possible. If used it should be used sparingly.

6.5.2.3 Leak Check

After assembly at the test site, the sampling train is checked for leaks by plugging the nozzle inlet and adjusting the vacuum to the maximum anticipated operating vacuum or 15 inches of mercury, whichever is greater. If a leakage rate (flow through the gas meter) greater than 0.02 cubic feet per minute is obtained, the leak must be found and repaired, and the leak check procedure must be repeated until satisfactory. Procedures for leak checking sampling trains are given in Appendix J. After the leak check, the vacuum should be released slowly by unplugging the nozzle before shutting off the pump. Failure to do so can cause a pressure surge through the train which may rupture the filter or displace reagents in the impingers. Reset the meter to zero or record the meter reading before sampling is begun.

6.5.3 CONTINUOUS SAMPLING

Equipment errors can be minimized by proper maintenance of the instruments and quality control of the calibration gases. Calibrations must be conducted both pre- and post-test, as well as periodically throughout

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the test. The sample conditioning systems of the instruments can also introduce errors. Care must be taken in setting up a sample conditioning system so that the conditioning does not interfere with the measurement of the contaminant or species of interest. The sample handling/conditioning system must be leak checked as in Section 6.5.2.3.

6.5.4 MISCELLANEOUS

All sampling equipment must be cleaned carefully to prevent sample contamination. Chromic acid cleaning solutions are recommended for cleaning glassware prior to beginning a test series. For metal analyses, certain types of glassware should not be used, and cleaning with nitric acid is recommended. The method description should include guidelines for choosing sample contacting materials.

A checklist will help assure that all test equipment being used has a valid calibration and is in good operating condition.

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6.6 EQUIPMENT MAINTENANCE

Systematic errors arise from deficiencies inherent in the equipment or from inaccurate calibration. To minimize systematic errors, an effective maintenance and calibration program must be implemented. An equipment preventive maintenance program is described below, and the calibration program is presented in Section 6.7.

Preventive maintenance consists of those actions required to reduce equipment downtime, improve the reliability of source test results, and increase confidence in the results. The program consists of cleaning, lubricating, rebuilding, and adjusting equipment at predetermined intervals. A spare parts inventory should be maintained to assist in limiting equipment service time. A recommended spare parts list can usually be obtained from the manufacturer of each piece of equipment.

Preventive maintenance shall be performed on the following equipment:

- 1. Sampling pumps
- 2. Flow measuring devices (dry test meters, rotameters)
- 3. Pressure measuring devices (gauges)
- 4. Sampling instruments
- 5. Integrated sampling tanks
- 6. Mobile van sampling systems
- 7. Laboratory equipment (scales, etc.)

Other equipment may be added to the above list as required.

The service frequency shall be determined from experience and from manufacturer's recommendations. Each piece of equipment shall be

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identified by appropriate means, and each service should be recorded on a maintenance log sheet. Table 2 suggests acceptance limits and frequencies of maintenance for the equipment listed above.

ARB's procedures for scheduled maintenance and performance checks of mechanical test equipment are given in Appendix D. ARB's policy on preventive maintenance is to perform maintenance on a scheduled basis or whenever there are indications of performance deterioration or excessive wear.

The person in charge of the shop is responsible for:

- 1. Planning and implementing an equipment maintenance program
- Ensuring that all maintenance and calibrations are performed on schedule
- Maintaining equipment logs and keeping all service records up to date

The instructions for periodic maintenance, calibration, and special care of instruments and equipment are frequently updated. Abstracts from manufacturer's service and maintenance manuals are the primary sources for these updates. Also helpful is the assistance of factory representatives in initial installation and performance testing of the new instrument. And most important, manufacturer's instructions for operating an instrument must be followed to reduce error and prolong equipment life.

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TABLE 2

MAINTENANCE SCHEDULE

EQUIPMENT	ACCEPTANCE LIMITS	FREQUENCY OF SERVICE	METHOD OF SERVICE
Pumps	 Absence of Leaks Ability to draw manuf. req. vacuum and flow 	Every 500 hrs. of operation or 6 months whichever less	 Visual insp. Clean Replace worn parts Leak check.
Flow measuring device	 Free mechanical movement Absense of malfunction 	Every 500 hrs. of operation or 6 months whichever less	 Visual insp. Clean Calibrate (see Sec. VI)
		After each test if used in H ₂ S sampling or othe corrosive atmospl	r heres
Sampling Instruments	 Absence of malfunction Proper response to zero, span gas 	As required by manufacturer	As recommended by manufacturer
Integrated sampling tanks	l. Absence of leaks	Depends on nature of use	1. Steam clean 2. Leak check
Mobile van sampling systems	1. Absence of leaks	Depends on nature of use	 Change filters Change gas dryer Leak check. Check for system contamination
Sampling Lines	Sample degradation less than one percent	After each test or test series	Flush with freon Blow filtered air thru line until dry



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6.7 CALIBRATION

An effective program of equipment calibration is essential in assuring quality control of source test data. Virtually all source test measurement equipment requires periodic calibration checks of some kind. Since the specific equipment used by each agency varies, this section will include general guidelines for each type of equipment.

As a general rule, instruments and equipment used in source testing are calibrated at designated times and whenever major repairs are made. The calibration schedule, method of calibration, or standard of comparison and the acceptance limits for each analyzer are given in Table 3.

A record of each calibration is recorded in the instrument calibration logbook. This record must include the following information:

- 1. Instrument identification (serial or other identification number)
- 2. Date
- 3. Operator identification
- 4. Calibration technique
- 5. Description and identification of standard material used
- Test or other code -- for use in identifying samples for analysis by a referee (third-party calibration cross-checking)
- 7. Calibration curves, correction factors, etc.
- 8. Operator comments

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6.7.1 CONTINUOUS ANALYZERS (EXTRACTIVE TYPE)

A variety of calibration techniques are available, but virtually all of them involve traceability to a known standard or to referee and analytical methods of well-established performance. For procedures used for establishing traceability of gases see Appendix E.

Two types of calibration are performed on all continuous extractive analytical instruments:

- 1. Primary (laboratory) calibration
- 2. Field calibration

6.7.1.1 Primary Calibration

In a primary calibration the response of the instrument is compared with a number of primary standard reference materials (SRMs). Primary SRMs are gases or other substances whose concentration, purity, and integrity are guaranteed by a recognized standard setting body such as the National Bureau of Standards'(NBS).

The instrument's responses to five concentration levels within each working range are measured. Each response point is plotted on a graph. A calibration line (or curve) is constructed by drawing the line of best fit through the plotted points. This line should go through the origin of the graph. A test is applied to determine whether the instrument is within acceptable limits. For instruments with linear outputs, the largest deviation from the straight line may not exceed 2% of full scale at any point on the curve. The acceptable specification limits for each

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analyzer are given in Table 1. If the calibration curve is acceptable, that is, if it lies within the predetermined limits, the analyst can use it to translate instrument output into the appropriate concentrations. If the calibration curve is not acceptable, corrective action should be taken in accordance with the instrument's operating manual.

Changes within the instrument can cause the line of best fit to shift. Therefore, the instrument should be checked periodically by analyzing one of the SRMs used to construct the calibration curve.

6.7.2.2 Field Calibration

A field calibration consists of a functional check and a two-point calibration check (zero and span gas in expected concentration range). Field calibrations must be performed before starting and at the end of each test. During longer source tests, field calibration checks should be be made periodically during the test and clearly marked on the recording chart. To increase the confidence of a two-point calibration, the linearity of the instrument should also be checked at least once during the test if possible.

6.7.2 OTHER SOURCE SAMPLING INSTRUMENTS AND EQUIPMENT

The recommended frequency of calibration and methods used for calibrating sampling instruments and equipment are shown in Table 3. A standard reference material traceable to the NBS should be used when available. If not, use calibration procedures recommended by the manufacturer, EPA, or ASTM. Where there are no reference materials for calibrating some instruments and devices, these devices should be calibrated against devices or instruments known to provide

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a higher degree of accuracy. Generally the calibration standard for mechanical equipment should be four to ten times more accurate than the equipment being calibrated.

TABLE 3

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	SAMPLING	INSTRUMENTS	AMD	EQUIPMENT	CALIBRATION	SCHEDULE
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Instrument or Equipment Type	Frequency of Calibration	Standard of Comparison or Method of Calibration	Acceptance Limits
Orifice meter (large)	12 months	Calibrated Wet test meter	± 2% of volume measured
Orifice meter (small)	12 months	Bubble meter	± 2% of volume measured
Dry gas meter	12 months or when repaired	Wet test meter Bell Type spirometer	± 2% of volume measured
Roots gas meter	12 months or when repaired	Bell type spirometer	± 5% of volume measured
Turbine meter	12 months or when repaired	Bell type spirometer	± 2% of volume measured
S-Type pitot tube (for use with EPA type sampling train)	6 months	EPA Method 2 See 4.1:3	Cp constant >±5% over working range Difference between the average Cp for each leg must be less than 2%
Vacuum gauges Pressure gauges	6 months	Manometer	± 3%
Field barometer	6 months	Mercury Barometer	± 0.2" Hg.
Temperature measuring	6 months	NBS Mercury Thermometer or NBS Calibrated Platinum RTD <u>1</u> /	± 4 ⁰ F for Temp. <400 ^D F ± 1.5% for Temp >400 ^D F
Temperature readout devices	6 months	Precision Potentiometer	± 2% Full Scale reading
Analytical balance	12 months	Should be performed by manufacturer cr quali- fied laboratory	± 0.3 mg of stated weight
Probe nozzles	12 months	Nozzle diameter check Micrometer	Range >±0.10 mm for 3 measurements
Continuous analyzers	Depends on use frequency	As specified by manu- facturers operating manuals EPA NBS Gases and/or Ref. Methods	Satisfy all limits specified in performance specifications

1/ RTD - Resistance Temperature Device



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6.8 QUALITY CONTROL IN CONDUCTING TESTS

The care with which the test team member makes instrument readings and performs various tasks controls the reliability of the data obtained from the test. Quality control procedures for different sampling methods are given here.

6.8.1 GRAB SAMPLING

In grab sampling, the probe or sample line is inserted into the stack and a portion of the flue gas stream is drawn through the sample line to purge all of the air from the system. A vacuum pump is used to draw the sample into a container or flask. For evacuated flasks, a vacuum gauge may be used between the valve and the flask to assure that the flask is still fully evacuated before the sample is taken. Multiple samples at each location must be taken to increase the reliability of the data.

6.8.2 INTEGRATED SAMPLING

6.8.2.1 Gaseous Samples

This method differs from grab sampling in that an orifice or restrictor is installed in the sample line to control the amount of flow to the evacuated container or flask. Purging of the sample line as described under grab sampling should be accomplished.

6.8.2.2 Particulate Matter Samples

The sample rate must be proportional to the stack velocity, and to assure a representative sample the sample probe must traverse the entire stack cross section for most tests. The minimum number

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and location of sample points are to be as determined by Method 1 or from the test methods described in Appendix B.

To keep an isokinetic sampling rate, different rates of collecting the sample will be utilized when traversing the stack. The reading of the pressure sensing device and the condition of the pitot tube will affect the accuracy of the data. Frequent pitot tube calibrations and exact readings by the test personnel will reduce errors in this area.

After the test is completed and the final readings are recorded, a leak check is made of the sampling train. If the leakage rate is greater than 0.02 cubic feet per minute, discard test sample, correct the leak, and take a new sample.

To avoid contamination of the sample, cover the nozzle tip as soon as possible after the test run. As the sampling train is disassembled, all disconnected sections are also covered to prevent contamination. Extreme care must be exercised so that all sections of the sampling train are properly labeled for positive identification before transportation to the laboratory for analysis. It is recommended that one test team member be assigned for the responsibility of monitoring the test samples to protect them from loss, breakage, or contamination. Chain of custody procedures are used to preserve sample integrity while in transit to the
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laboratory and during the laboratory analysis. See Section 6.8.5 below for more discussion on chain of custody.

6.8.3 CONTINUOUS SAMPLING

In continuous sampling a probe or sample line is inserted into the stack; at a specific flow rate the gases are passed through a conditioner system and then to an electronic analyzer. The conditioner is normally designed to remove particulate matter and moisture but may also contain reagents to remove other gases that interfere with the specific contaminant being measured. Care must be exercised in adjusting the flow rate to the instrument during the test so that it is the same as was used during the pre-test calibration (zero and span). All necessary data must be recorded on a standardized form such as shown in Appendix G. Any shift between pre- and post-test calibration should be noted, along with any nonlinearity that may have been revealed in the periodic multipoint calibration of the instrument.

6.8.4 RECORDING OF DATA

All data relating to the operation of the sampling train must be carefully recorded on the field data sheet during the test. Any unusual occurences in the process operation, unusual test instrument readings, or items that could possibly affect the test results should be noted on the data sheet. It is recommended that a checklist be used to assure all data needed for test calculations or process information are obtained.

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6.8.5 CHAIN OF CUSTODY

For all types of testing, a chain of custody procedure must be used to assure that the sample analyzed is actually the sample taken under the conditions reported. Errors can be caused by delays in cleaning, contamination of the sample, and improper identification of the sample. The chances for error are greatly increased when too many people are permitted to handle samples. It is recommended that the responsibility for handling the samples be given to <u>one</u> person on the source test team and to <u>one</u> laboratory staff member. Ideally, a chemist would prepare the sample reagents or filter and then sign over these items to a test team technician, who will handle them at the test site, attach identification labels after testing, and return them to the same Chemist at the laboratory for analysis. A chain of custody form bears the names of the persons who prepared the reagents and the sampling train, recovered the sample, delivered the sample to the laboratory, and performed the laboratory analysis.

If the sample is not going to be analyzed immediately at the laboratory, a secure area must be used to store the sample.

6.9 POST-TEST QUALITY CONTROL PROCEDURES

Significant errors can occur when data are not reduced properly. Besides the sampling and analytical errors occuring during the test, human error can be introduced at any time between sample collection and data reporting.

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6.9.1 INITIAL EXAMINATION OF DATA

As part of the post-test procedures, test data sheets should be examined to determine if any of the sheets contain any obviously abnormal values. Examine each abnormal value and correct whenever possible. However, the presence of an error may not be a sufficient reason for rejecting an entire test. Depending on the significance of the error a judgement can be made as to the acceptability of the results. A record should be maintained of test values which are judged to be invalid or otherwise suspicious.

6.9.2 DATA REDUCTION

Data reduction must take place with the aid of a standard calculation form or computer. The form should include step by step procedures required to obtain accurate final results. Computers are useful tools for handling large amounts of data and simplifying complex calculations and should be used whenever possible. All calculations and computer inputs must be checked by at least two people. Before the report is finished, the supervisor must make a final review and make the final decision of the validity of the data.

Data from continuous emission analyzers are recorded on strip charts. Strip chart recordings should be integrated with the use of a planimeter or similar device unless the recording is relatively constant with time. Data from strip charts must be checked by a supervisor.

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6.9.3 VALIDATING DATA

Once the test results have been calculated, with adequate precautions taken to assure accuracy, the next problem is determining if the results are representative of the actual emissions. Variability in results derived from multiple tests conducted on the same source at different times may be due to part or all of the following:

- 1. Variations in source operating parameters
- Testing equipment and personnel variations both in the field and in the laboratory
- 3. Uncertainties inherent in the test method

Variations in the source operation may often be the most significant factor in the total variability of the test results. Knowledge of the source operation and monitoring of key operating parameters help to identify these variations. Variations caused by personnel can be minimized by operating a good training program. A good preventive maintenance program helps minimize variations in equipment operation.

The uncertainty of the results is an important aspect in determining the test's reliability. There are a number of statistical methods available for determining the uncertainty of test results. Appendix A contains the derivation and sample calculations for one method.

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Other useful tools for validating source test results are control charts that historically identify each test result with control limits to identify outliers (problem data).

When source test results fall outside of the control limits established by control chart calculations, the following questions should be asked:

- 1. Was the source operation varying?
- 2. Were the test data recorded and reduced properly?
- 3. Were equipment problems or probable human error encountered during the test?
- 4. Was the test method used appropriate for the source tested?

If the cause of the variations in results can be determined, the test report should note the problem, and another test should be conducted if necessary.

Reported results should, whenever possible, include the confidence interval of the results (for example, 120 ppm \pm 10 ppm) for each run. The confidence interval can be obtained from the uncertainty analysis or from other statistically sound methods. The arithmetic mean should also be reported. ×.

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6.10 QUALITY ASSURANCE AUDITS

A quality assurance audit should be conducted by someone who is not a regular member of the source test team. This person will conduct performance audits and check source test results. Performance audits should be made periodically according to the organization's needs. Performance audits fall into three distinct phases:

1. Sampling audits

2. Analysis audits

3. Data processing audits

6.10.1 SAMPLING AUDIT

A complete sampling audit should consist of simultaneous testing using different equipment and different operators. However, this type of audit is not always practical from a cost and personnel standpoint. In most cases, an acceptable sampling audit consists of a qualitative appraisal of the test procedures and test equipment used during the test. The auditor must verify that all equipment is functioning properly during the test and that all of the pre-test performance and calibration checks were made.

6.10.2 ANALYSIS AUDIT

An analysis audit consists of separate analyses of commonly collected integrated samples. Samples of known concentration can be submitted to two or more independent laboratories (interlaboratory testing). Samples can also be evaluated by separate chemists in the same laboratory (intralaboratory testing).

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6.10.3 DATA PROCESSING AUDIT

Data processing audits consists of spot-checks of data reduction and calculation procedures. Computation methods are checked by inserting "dummy" data sets into computer programs and calculation sheets.

6.10.4 USE OF A CHECKLIST

Checklists may be used to assist in conducting audits. However, no checklist can cover all situations, so good judgement must be used by the auditor. If problems are found during any phase of a performance audit, the auditor should make every effort to locate and correct the problem. However, all problems must be recorded for later review.

A periodic review of the preventative maintenance program should be included as part of the audit process. This would consist of monitoring equipment downtime.

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6.11 QUALITY ASSURANCE REPORTING

A quality assurance report to the manager of the source testing section should be made periodically to outline the important aspects of the quality assurance program. The report should include pertinent facts in a short format.

The following items could be included:

1. System audit results

- 2. Performance audit results
- 3. Instrument or equipment operation
- Percent voided samples versus total samples
- 5. Interlaboratory test results
- 6. Intralaboratory test results
- 7. Status of solutions to major problems
- 8. Recommendations for source test procedure changes

The format and content of the report will differ for each organization depending on its source test program.

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6.12 TRAINING

Personnel related errors arise due to carelessness, insufficient knowledge, or inadequate training. Many of these errors can be reduced by use of a training program for test personnel. The training should cover:

- 1. Operation and maintenance of equipment
- 2. Detection of electronic problems
- 3. Detection of sensor problems
- 4. Detection of mechanical problems
- 5. How to perform routine field repairs
- 6. How to calibrate instruments
- Limitations of the instruments (range, responses, interference functions, temperature limits, moisture limitations, etc.)

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Appendix A



APPENDIX A

CALCULATIONS FOR ESTIMATING RANDOM ERROR

The purpose of this analysis is to provide guidelines for estimating the maximum probable random error $(\pm 3\sigma)$ involved in taking a single measurement in the field or in deriving a single point source test result. Each probable random error is based on the expected precision with which a piece of equipment can be read.

Any systematic errors due to improper calibration, faulty equipment, or inadequate test procedures will be in addition to the probable random error.

In this analysis, expected random errors for direct measurements are given first. Then the compounded random errors expected in calculated results are shown. The following statistical method is used to compute random error.

If $Z = f(x, x_2, ...)$ and is differentiable, then

$$\begin{bmatrix} \Sigma \left(\frac{\partial z}{\partial x_{i}}\right) & 2 & e_{i}^{z} \end{bmatrix}$$

$$e_{z} = \text{probable maximum error in } z$$

$$e_{i} = \text{probable maximum error in } x_{i}$$

EXAMPLE

$$V_o = C \frac{Vm Pb}{Tm}$$

e_z =

where:

 V_o = corrected meter volume V_m = uncorrected meter volume P_b = barometric pressure T_m = meter temperature C = a constant

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$$\frac{\delta}{\delta} \frac{V_{0}}{V_{m}} = C \frac{P_{b}}{T_{m}}$$

$$\frac{\delta}{\delta} \frac{V_{0}}{P_{b}} = C \frac{V_{m}}{T_{m}}$$

$$\frac{\delta}{\delta} \frac{V_{0}}{T_{m}} = C \frac{V_{m}P_{b}}{T_{m}^{2}}$$

Let: e_{V_0} = The probable maximum error in V_0 e_{V_m} = The probable maximum error in V_m e_{P_b} = The probable maximum error in P_b e_{T_m} = The probable maximum error in T_m

Then:
$$e_{V_0}^2 = (C \frac{P_b}{T_m})^2 e_{V_m}^2 + (C \frac{V_m}{T_m})^2 e_{P_b}^2 + (-C \frac{V_m P_b}{T_m^2})^2 e_{T_m}^2$$

Divide by
$$V_0^2$$
:

$$\frac{e_{V_0}^2}{V_0^2} = \frac{\frac{C^2}{T_m^2} \quad p_b^2 \ e_{V_m^2} + V_{meP_b^2}^2 + \frac{V_m^2 p_b^2}{T_m^2} e_{T_m^2}}{\frac{C^2 V_m^2 p_b^2}{T_m^2}}$$
Let:
 $\gamma \cdot V_0 = \frac{e_{V_0}}{V_0} = \text{The relative error in } V_0$
 $\gamma V_m = \frac{e_{V_m}}{V_m} = \text{The relative error in } V_m$
 $\gamma P_b = \frac{e_{P_b}}{P_b} = \text{The relative error in } P_b$
 $\gamma T_m = \frac{e_{T_m}}{T_m} = \text{The relative error in } T_m$

Then:
$$\gamma V_o = \left[\gamma^2 V_m + \gamma^2 P_b + \gamma^2 T_m \right]^{1/2}$$

NUMERICAL EXAMPLE

The data used in this example were taken from an actual particulate source test. The maximum expected random error for each measurement is presented in the following format:

$$\frac{+}{2} \gamma_{i} = \frac{e_{i}}{x_{i}} (100)$$

where γ_i = relative uncertainty, %

e_i = uncertainty of measurement x_i = actual reading from equipment

 $\gamma P = \frac{0.03^* \text{in H}_20}{0.44 \text{ in H}_20} \times 100$

2. Duct gauge pressure, PD

$$\gamma P_D = \frac{0.03^* \text{ in Hg}}{1.00 \text{ in Hg}} \times 100$$

= + 0.3%

3. Stack temperature, T_D

$$YT_b = \frac{5^{\circ}R}{1130^{\circ}R} \times 100$$

= + 0.4%

4. Meter temperature, T_m

$$\gamma T_{\rm m} = \frac{5^{\rm o} {\rm R}}{514^{\rm o} {\rm R}} \times 100$$

= $\pm 0.97\% \simeq 1.0\%$

*includes fluctuations in reading due to turbulence in the stack 5. Meter volume, V_m

$$\gamma V_{m} = **2 \times \frac{0.02 \text{ ft}^{3}}{25 \text{ ft}^{3}} \times 100$$

= 0.16%

- **accounts for initial
 and final meter readings
- 6. Saturated gas temperature, T_s

$$\gamma T_{s} = \frac{0.5^{\circ}R}{498^{\circ}R} \times 100$$

= $\pm 0.1\%$

7. Saturated gas pressure in impingers, Ps

This is based on the saturated gas temperature in the impingers which is accurate to $\pm 1/2^{\circ}F$.

$$\gamma P_{s} = \frac{P_{38}o_{F} - P_{37.5}o_{F}}{P_{38}o_{F}}$$
$$\gamma P_{s} = \frac{0.2292" \text{ Hg} - 0.2248" \text{ Hg}}{0.2292" \text{ Hg}} \times 100 = \pm 1.9\%$$

8. Condensate weight, W_C

$$\gamma W_{\rm C} = ***2 \times \frac{0.05 \text{ gm}}{120 \text{ gm}} \times 100$$

***accounts for two weighings

$$= + 0.1\%$$

9. Filter weights,
$$W_p$$

 $\gamma W_p = ***2 \times \frac{0.002 \text{ gm}}{0.10 \text{ gm}} \times 100$
= + 0.4%

10. Pitot tube coefficient, c_p estimated as \pm 1.2% by the EPA.

11. Stack diameter, D

$$\gamma D = \frac{1 \text{ in}}{168 \text{ ins}} \times 100$$

= + 0.60%

12. Time, t

$$\gamma t = \frac{0.01 \text{ min}}{60 \text{ mins}} \times 100$$

= 0.02%

13. Nozzle diameter,
$$D_n$$

 $\gamma D_n = \frac{0.1 \text{ mm}}{6 \text{ mm}} \times 100$
=1.7%

14. Barometric pressure, P_b $\gamma P_b = \frac{0.05" \text{ Hg.}}{30" \text{ Hg.}} \times 100$ $= \pm 0.2\%$

UNCERTAINTY ERRORS IN CALCULATED RESULTS

Corrected meter volume, Vo

$$V_{o} = \frac{P_{b}V_{m}}{T_{m}}$$

$$\gamma^{2}V_{o} = \gamma^{2}V_{m} + \gamma^{2}P_{b} + \gamma^{2}T_{m}$$

$$\gamma V_{o} = [(0.16)^{2} + (0.2)^{2} + (1.0)^{2}]^{1/2}$$

$$= 1.03\%$$

Water vapor content

% H₂0 =
$$\frac{0.0474 W_{C} + C}{V_{0} + 0.0474 W_{C} + C}$$

where: $C = \frac{V_{0}P_{S}}{P_{b} - P_{i} - P_{S}}$
 $\gamma^{2}C = \gamma^{2}V_{0} + \gamma^{2}P_{S} + \gamma^{2}P_{b} + \gamma^{2}P_{i}$
 $\gamma C = [(1.9)^{2} + 2(1.9)^{2} + (0.2)^{2} + (2.9)^{2}]^{1/2}$
 $\gamma C = \pm 4.4\%$
 $\gamma^{2}H_{2}0 = 2\gamma^{2}W_{C} + 2\gamma^{2}_{C} + \gamma^{2}V_{0}$
 $\gamma H_{2}0 = [2(0.1)^{2} + 2(4.4)^{2} + (1.03)^{2}]^{1/2}$
 $= \pm 6.3\%$

Assume: % $H_2^0 = 2 - eH_2^0 = \pm 1.3\%$ water vapor The error in the dry portion $(1 - \% H_2^0)$ is: $\gamma dry = \gamma (1-H_2^0) = \frac{1.3}{80} \times 100$ $= \pm 1.6\%$

Molecular weight, MW

The Orsat Analyzer is estimated to be accurate within ± 0.2% for each component.

$$\gamma^{2} \text{CO}_{2} = \gamma \text{dry}^{2} + \gamma^{2} \text{CO}_{2} = (1.6)^{2} + \left(\frac{0.2}{8}\right)^{2} \approx (1.6)^{2}$$

$$\gamma^{2} \text{O}_{2} = \gamma^{2} \text{ dry} + \gamma^{2} \text{ O}_{2} = (1.6)^{2} + \left(\frac{0.2}{8}\right)^{2} \approx (1.6)^{2}$$

$$\gamma^{2} \text{CO} = \gamma^{2} \text{ dry} + \gamma^{2} \text{CO} = (1.6)^{2} + \left(\frac{0.2}{1}\right)^{2} \approx (1.6)^{2}$$

$$\gamma^{2} \text{N}_{2} = \gamma^{2} \text{ dry} + \gamma^{2} \text{ N}_{2} = (1.6)^{2} + \left(\frac{0.2}{85}\right)^{2} \approx (1.6)^{2}$$

$$= \gamma^{2} \text{ CO}_{2} + \gamma^{2} \text{ CO}_{2} + \gamma^{2} \text{ CO} + \gamma^{2} \text{ N}_{2}$$

$$\gamma \text{MW} = \begin{bmatrix} 4 & (1.6)^{2} \end{bmatrix}^{1/2}$$

$$= \pm 3.2\%$$

Stack gas velocity

$$V_{s} = 85.55^{C}P \ [\Delta p^{1/2}] \text{ avg } \left[\frac{T_{D}}{(P_{D}^{+} + P_{b}) MW} \right]^{1/2}$$

$$\gamma^{2} V_{s} = \gamma^{2} C_{p} + 0.25 \ (\gamma \Delta P)^{2} + 0.25 \ [\gamma^{2} T_{D}^{+} + \gamma^{2} P_{d}^{+} + \gamma^{2} MW]$$

$$\gamma V_{s} = \left[(1.2)^{2} + 0.25 \ (6.8)^{2} + 0.25 \ \left\{ (0.4)^{2} + (0.2)^{2} + (3.0)^{2} + (3.2)^{2} \right\} \right]^{1/2}$$

$$\gamma V_{s} = \pm 4.2\%$$

Stack cross-sectional area

$$A = \frac{\pi D^2}{4}$$

$$\gamma^2 A = 1/2 (\gamma_D)^2$$

$$\gamma A = 1/2 (0.60)^2$$

$$\gamma A = \pm 0.30$$

Stack gas flow rate

$$Q_{0} = \frac{(10.6) V_{s} A(P_{b} + P_{d}) (100 - \% H_{2}0)}{T_{D}}$$

$$\gamma^{2}Q_{0} = \gamma^{2}V_{s} + \gamma^{2} P_{b} + \gamma^{2} dry + \gamma^{2} T_{D}$$

$$\gamma Q_{0} = [(4.23)^{2} + (0.30)^{2} + (0.2)^{2} + (3.0)^{2} + (1.6)^{2} + (0.4)^{2}]^{1/2}$$

$$\gamma Q_{0} = \pm 5.5\%$$

Particulate grain loading

$$G = \frac{15.43W}{V_0}$$

$$\gamma^2_{G} = \gamma^2_{W} + \gamma^2_{V_0}$$

$$\gamma G = [(4.0)^2 + (1.03)^2]^{1/2}$$

$$\gamma G = \pm 4.13\%$$

Particulate mass emission rate

$$M = \frac{Q_0 G}{116.7}$$

$$\gamma^2 M = \gamma^2 G + \gamma^2 Q_0$$

$$\gamma M = [(4.13)^2 + (5.5)^2]^{1/2}$$

$$\gamma M = \pm 6.9\%$$

Isokinetic ratio I

$$I = \frac{(100 - \% H_20) \text{ AV st Tm}}{(T_D) (Q_m)}$$

$$\gamma^2 I = \gamma^2 dry + \gamma^2 A + \gamma^2 V_s + \gamma^2 t + \gamma^2 T_D + \gamma^2 V_m$$

$$\gamma I = \left[(1.6)^2 + (0.3)^2 + (4.2)^2 + (0.02)^2 + (1.0)^2 + (0.4)^2 + (.16)^2 \right]^{1/2}$$

$$\gamma I = \pm 4.6\%$$

SUMMARY

Measured Quantities

	± Relative Uncertainty, %
Velocity Head, P	0.68
Duct Gage Pressure, P _D	0.3
Stack Temperature, T _D	0.4
Meter Temperature, T _m	1.0
Meter Volume, V _m	0.2
Saturated Gas Temperature, T _s	0.1
Saturated Gas Pressure, P _s	1.9
Condensate Weight, W _c	0.1
Filter Weights, W _p	0.4
Pitot Tube coefficient, C _p	1.2
Stack Diameter, D	0.6
Time, t	0.02
Nozzle Diameter, D _n	1.7
Barometric Pressure, P _b	0.2
Calculated Quantities	
Corrected Meter Volume, Vo	1.03
Water Vapor Content, % H ₂ O	6.3
Dry Volume, (1 - %H ₂ 0)	1.6
Molecular Weight, MW	3.2
Stack Gas Velocity, V _s	4.2
Stack Cross-Sectional Area, A	0.3
Stack Gas Flow Rate, Q _o	5.5
Particulate Grain Loading, G	4.13
Particulate Mass Emission Rate, M	6.9
Isokinetic Ratio, I	4.6

A - 9



APPENDIX B

This appendix is available from the Air Resources Board's Public Information Office



Appendix C



APPENDIX C

STATE OF CALIFORNIA AIR RESOURCES BOARD

Engineering Investigation Report

COUNTY	FILE No.	DATE OF VISIT	INVESTIGATED BY
1 46710N			
I. MOTION			
Local authorities contacted	Suspected	source of pollution tou	red D
🗆 Problem area survayed	D Possible so	ampling sites located	
Complaintant interviewed	Time of visit _	to	_ 0 .
2. RECOMMENDATIONS			
🗆 No air pollution problem			
D Further investigation (explai	in)		
D Information required from			· ·
Stack test (if recommended a. Accessibility of sampli	d, complete the following ing ports)	
b. Straight stack diamete	ers upsteam and downstree	om of ports	
c. Stack diameter (ft.)		e. Velocity of	flue gas (FPM)
o. Moisiure content (%)	f. Temperatur	e of flue gas
S. COUNTY OFFICIAL CONTAC	TED		
Name and address (include ti	ie }		
Name and address (Include ti 4. SUSPECTED SOURCE OF AIR	POLLUTION		
Name and address (Include ti SUSPECTED SOURCE OF AIR Name and address	POLLUTION		Production rate
Name and address (Include 1) 4. SUSPECTED SOURCE OF AIR Name and address	POLLUTION		Production rate Tons/year Tons/day
Name and address (include ti SUSPECTED SOURCE OF AIR Name and address	POLLUTION	*	Production rate Tons/year Tons/day Operating schedule
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Name and address (include ti SUSPECTED SOURCE OF AIR Name and address COMPANY OFFICIALS INTERVIEV Name (include title) SPECIFIC COMPLAINT (PARTIC	POLLUTION WED	° CY, EFFECTS, ETC.)	Production rate Tons/year Tons/day Oparating schedule Days/week Hours/day Company official to contact
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Name and address (include ti SUSPECTED SOURCE OF AIR Name and address COMPANY OFFICIALS INTERVIEV Name (include title) SPECIFIC COMPLAINT (PARTIO	POLLUTION WED CULATE, ODOR, FREQUEN	CY, EFFECTS, ETC.)	Production rate Tons/year Tons/day Oporating schedule Days/week Hours/day Company official to contact
Name and address (Include ti SUSPECTED SOURCE OF AIR Name and address COMPANY OFFICIALS INTERVIEV Name (Include title) SPECIFIC COMPLAINT (PARTIC	POLLUTION WED CULATE, ODOR, FREQUEN	• CY, EFFECTS, ETC.)	Production rate Tons/year Tons/day Oparating schedule Days/week Hours/day Company official to contact
Name and address (include ti Name and address Name and address COMPANY OFFICIALS INTERVIE Name (include title) SPECIFIC COMPLAINT (PARTIC ATTACHMENTS	POLLUTION WED CULATE, ODOR, FREQUEN	CY, EFFECTS, ETC.)	Production rate Tons/year Tons/day Oporating schedule Days/week Hours/day Company official to contact

-			
8.	SOURCE PROCESS DESCRIPTION (MATERIAL	S USED, AMOUNTS, ETC.)	
9.	SOURCE POLLUTION CONTROL EQUIPMENT		
	Туре	Manufacturer	
	Creatility	E #41a1-aa-	
	Сарасну	ETTICIENCY	
-	MONITORING BROCKAM		
-	MONITORING PROGRAM		
10.	OBSERVATIONS		
			and the second sec

Appendix D



APPENDIX D

PROCEDURES FOR ROUTINE MAINTENANCE AND PERFORMANCE CHECKS OF MECHANICAL TEST EQUIPMENT

TIME REQUIREMENTS

All portable test equipment, including pumps, dry test meter, tanks, thermometers, thermocouple potentiometers, magnehelic gauges, pitot tubes, and tanks, is inspected, serviced (as necessary) and performance-checked at six-month intervals.

Records of service are kept in the maintenance log.

PROCEDURES

- A. PUMPS
 - 1. Pumps which have been used very infrequently during the preceding maintenance interval and have not contacted contaminating or corrosive materials need not be serviced or tested. "Not used" should be entered in the log, in such a case.
 - Disassemble, inspect and clean valves, seals, and air-contacting surfaces. Repair and clean or replace mechanical parts as necessary.
 - 3. Repair or replace electrical connections or cords, if necessary.
 - 4. Repair or replace gauges, if necessary.
 - 5. Clean and fill oil reservoirs on oil-lubricated pumps.
 - Measure the maximum pressure, vacuum, and flow generated by the pump.
 - 7. Record the data obtained in 6, describe any repairs made, and enter the date of next service in the maintenance log.
- B. GAS FLOW AND VELOCITY METERS

Types of Meters in Use

- 1. Velocity meters (oriface, rotameter)
- 2. Dry gas meters
- 3. Roots gas meters
- 4. Turbine meters

Orifices, rotameters, etc. These devices are calibrated by connecting them in series with a more accurate volume meter, such as a calibrated wettest meter. Calibration should be performed at least every 12 months, depending on frequency of usage. Calibration curves with deviations of no more than 1% should be established for each device.

 G^{ac} flow meters in use are calibrated twice each year. These meters are calibrated against an NBS primary standard or equivalent. Acceptable primary standards are (1) bell type spirometer, or a (2) wet-test meter that was calibrated using an NBS standard flow meter. A calibration curve giving efficiency versus flow rate is plotted for each meter. Acceptance limits are ±1% of volume measured using an NBS traceable standard flow meter. Meters which are found to exceed the acceptance limits are taken out of service.

- Meters which have been very infrequently used during the preceding maintenance interval need not be tested. Enter "not used" in the log in such a case.
- 2. Check meters for good operation.
- 3. Send operational meters to California Division of Measurement Standards for calibration. Attach the calibration record to the maintenance log, and indicate the calibration and date of next inspection on each meter.
- C. PITOT TUBES
 - Type S pitot tubes should be calibrated against a standard pitot tube in a wind tunnel with a diameter at least 10 times the maximum dimension which the pitot tube presents perpendicular to the gas stream. Both the standard and type S tubes should be connected to water manometers or equivalent.

Type S - pitot tubes calibration. Compare with a standard type pitot tube by inserting both pitot tubes into a forced air duct and measuring the velocity at a specified point. A correction factor C_p is then calculated as shown in Table A.

Standard Pitot Reading		Type S Pitot Reading			
Ho	~H _o	Hl	$\sqrt{H_1}$	Ratio $\sqrt{H_0} = C_p$	
0.3	0.5477	0.415	0.642	0.853	
0.5	0.7071	0.700	0.837	0.844	
1.0	1.000	1.44	1.200	0.833	
				$C_{p} = 0.843$	

TABLE A

H. = Velocity head ("H₂0)

 $H_1 = Velocity head ("H_20)$

C_n = Pitot tube coefficient

The type S pitot tube is inverted and an average C_p for the other leg is obtained using the same procedure. The averages are compared and if they differ by more than 2% the type S pitot tube is disgarded.

If the pitot tube is acceptable, record the date of the calibration in the maintenance log, and indicate the date of next scheduled calibration,

D. TANKS

- 1. Disassemble and clean the valve, if corroded.
- Evacuate the tank, note the vacuum gauge reading, and check the gauge after 24 hours. No change should be noticed. Correct any leak or tag the tank "unserviceable".
- 3. Record the date of inspection and the date of next inspection on the tank and in the maintenance log.

E. POTENTIOMETERS

- 1. Test the battery and replace, if necessary.
- Connect the potentiometer to an appropriate thermocouple and insert the thermocouple in a beaker of boiling water. If potentiometer is temperature-compensated, record the temperature indication; if it is not compensated, record the millivolt output. Repeat the procedure in a beaker of ice water. Then subtract the two millivolt or temperature measurements and convert to degrees C.

- 3. Record the potentiometer outputs and the date of next inspection on the potentiometer and in the Maintenance log.
- If the output difference between the 0° and 100° tests is not between 98°C and 102°C, the potentiometer is unserviceable.
- F. THERMOMETERS
 - Record the thermometer reading in a beaker of ice water and a beaker of boiling water. Calculate the average deviation from 0°C to 100°C. If the deviation is over 4°C, the thermometer is unserviceable.

Bimetallic dial-type thermometers are commonly used. These should be checked against an NBS mercury-in-glass thermometer and adjusted to read correctly. All thermometers used in a sampling program should be checked against an NBS thermometer prior to use and should be adjusted to the following limits:

> 150° F. $\pm 2^{\circ}$ $150-500^{\circ}$ $\pm 5^{\circ}$ 500° $\pm 10^{\circ}$

- 2. Tag the date of inspection and next inspection on the thermometer along with the deviation.
- G. MAGNEHELIC GAUGES
 - Zero the gauge then test at 25%, 50% and 75% of range against a water manometer or an inclined manometer. Calculate the average deviation from the correct pressures. If the average deviation exceeds 5% of full scale, the gauge is unserviceable.
 - 2. Record the average deviation, date of inspection and date of next inspection in the maintenance log.
Appendix E



PROCEDURES FOR ESTABLISHING TRACEABILITY OF GASES FOR CALIBRATING

Claims of traceability established by manufacturers or vendors should not be relied upon. Calibration gases should be analyzed by analytical chemists. The chemist may elect to use either an analytical instrument such as a gas chromatograph or wet chemical methods in calibrating cylinder gases. The chemist must follow the prescribed procedures to assure the precision and accuracy of the cylinder gas analysis.

No gas cylinder is to be analyzed prior to the fifth day after filling, this is to permit the concentration to stabilize. All analyses are performed in triplicate to expose erroneous data points and excessive random variations in instrument response.

PROTOCOL FOR ANALYTICAL GAS CYLINDER ANALYSIS

- 1. Analyze each cylinder gas directly against the nearest standard reference material (SRM) by alternate analyses of the SRM and calibration gas in triplicate. Adjust the instrument span if necessary prior to analysis. No instrument adjustments are permitted during the triplicate analyses. The response to zero gas is frequently checked so that the change in successive zero responses do not exceed 1% of full scale.
- For each of the six analyses, determine the apparent concentration of the SRM or cylinder gas from the calibration curve.
- 3. For each pair of analyses (one SRM and one cylinder gas), calculate the concentration of the cylinder gas by:

True Conc of Cyl. Gas = Apparent Conc. of Cyl. Gas x True Conc. of SRM Apparent Conc of SRM

- Determine the mean of the three values for true concentration of the cylinder gas.
- 5. If any one value differs from the mean by greater than 1.5%, discard the data, reset the instrument span, if necessary, and repeat steps 1 to 4.

The following information is recorded on a label affixed to the cylinder.

- 1. Cylinder number
- 2. Mean concentration of cylinder gas, ppm or mole"%
- 3. Replicate analysis data

4. SRM number use as primary standards

5. Analytical principle used

6. Date of analysis

A cylinder calibration analysis report including all of the data shown above is prepared. This report should be placed in the files and maintained for three years

PROCEDURE FOR INSTRUMENT CALIBRATION

The following procedure for periodic multipoint calibration and daily instrument span checks is prescribed to minimize systematic errors. Separate procedures are used to perform span checks for linear and nonlinear instruments. In this context, a linear instrument is defined as one that yields a calibration curve which deviates by 2% of full scale or less from a straight line drawn from the point determined by zero gas to the highest calibration point. To be considered linear, the difference between the concentrations indicated by the calibration curve and the straight line must not exceed 2% of full scale at any point on the curve.

INSTRUMENT SPAN CHECKS

LINEAR RESPONSE ANALYTICAL INSTRUMENT

At the start and end of each test day (or test period) during which cylinder gases are to be analyzed, check instrument response to the highest SRM in the range to be used and to zero gas. Adjust response to the value obtained in the most recent multipoint calibration. Cylinder gases analyzed with a linear instrument must not have a concentration greater than 15% above the highest available SRM concentration.

NON-LINEAR RESPONSE ANALYTICAL INSTRUMENT

At the start of each test day (or test period) during which cylinder gases are to be analyzed, check instrument response to two SRMs in the range of calibration gases to be analyzed and to zero gas as follows. First, set the instrument zero with zero gas and then adjust the instrument response to the highest SRM available or to the value obtained in the most recent multipoint calibration. Next, make one check with the SRM nearest in concentration to the expected concentration of the source. If the response to the lower standard varies by greater than 2% from the response obtained, in the most recent multipoint calibration, a full multipoint calibration must be performed. Multipoint calibration will be discussed in detail in the next paragraph. Calibration gases analyzed with a non-linear instrument must not have a concentration greater than the highest available SRM concentration.

MULTIPOINT CALIBRATION

A multipoint calibration curve is prepared by using two SRM cylinder gases and a zero gas. The zero gas must not contain more than 0.2% of the full scale concentration of the component being analyzed. The zero gas must be free of any impurity that will give a response on the analytical instrument.

A multipoint calibration is accomplished by diluting the highest SRM with zero gas using a calibration flow system. Obtain the instrument response for points representing 0, 50, 90 and 100% of each expected range concentration curve. Obtain the instrument response for the other lower SRM without dilution. Compare the apparent concentration from the calibration of the lower SRM. If the difference between the apparent concentration and the true concentration of the lower SRM exceeds 2% of the true concentration, repeat the multipoint calibration procedure,

PROCEDURE FOR ANALYSIS OF CYLINDER GAS

The following procedure is designed to assure the precision and accuracy

of cylinder gas analyses. The analyses involve the direct comparison of the cylinder gas to the SRM in order to compensate for variations in instrument response between the time of the initial span check and the time of analysis. Significant variations in instrument response often result from changes in room temperture, line voltage etc. These variations are minimized by using air conditioned source test vans and by using the power supply available at the source during the entire testing, period including the intial calibration and span checks.

Vertification of Cylinder Gas Stability

The stability of reactive gases (including cylinder gas of nitric oxide and carbon monoxide) must be verified before use. The stability of cylinder gas is verified by performing a second set of triplicate analyses (using procedure described above) a minimum of 7 days after the first set of triplicate analyses. The mean of the second triplicate analyses must not differ from the mean of the first triplicate analysis by more than 1%.

Reanalysis of cylinder gases

All cylinder gases which are six months or longer in stock must be reanalysed before use.

Minimum Cylinder Pressure

No cylinder gas should be used below a cylinder pressure of 200 psi or 10% of its initial pressure.

Cylinder label and analysis report

Each gas cylinder should contain the following minimum traceability infor-

E-5

mation on a label affixed to the cylinder.

- 1. Cylinder number.
- 2. Mean concentration of cylinder gas, ppm or mole %.
- 3. Last recorded pressure.
- 4. Last analysis date
- 5. Date when reanalysis is required (six months after date shown in # 4).

The table below lists the required cylinder types and recommended intervals for checking span gas concentrations.

GAS	CYLINDER	FREQUENCY OF RE-CERTIFICATION*	MINIMUM USABLE CYLINDER PRESSURE, PSIG
S0 ₂	Aluminum	6 months	200
NO, NO _X	Aluminum	6 months	200
CO	Aluminum	6 months	200
HC	Aluminum <u></u> /	6 months	200 <u>2/</u>
C02	Aluminum ¹ /	6 months	2002/

*may be longer if guaranteed by manufacturer.

- ^{1/} Steel may be used if aluminum is not available
- 2/ 400 PSL with steel

Aluminum cylinders are much more effective than steel for stabilizing concentrations of SO_2 , NO_χ , and CO. This is partly because of the decreased cylinder surface area of the aluminum cylinders due to a much smoother surface. When aluminum cylinders are not available for SO_2 , NO_χ , and CO, steel containers may be used, but they should be re-certified once a month. The minumum usable cylinder pressures are shown above. This is important because changes in temperature moisture and vapor pressure produce

changes in concentration as the tank pressure decreases.

Newly purchases gas standards should always be checked against old ones as a basic check of the gases themselves, the gas manufacturer, and the sampling instrument. e. ÷. Appendix F



APPENDIX F

FIELD PROCEDURES USED IN COLLECTION AND RECOVERY OF SAMPLES

A. WATER TRAIN PER EPA METHOD 4

PRE TEST PROCEDURES

- Add 100 ml. deionized-distilled water to each of the first 2 impingers of the train.
- Interconnect the four impingers with pre-cut 16-inch lengths of vinyl tubing.
- c. Weigh desiccator unit and record weight.
- d. Attach desiccator unit to last impinger of the train.
- e. Add water and ice to impinger case.
- f. Connect vinyl line between desiccator unit and umbilical line.
- g. Connect stainless steel. Probe to first impinger with suitable vinyl tubing.
- h. Leak check assembled train.
- i. Sample at 0.75 CFM for 15 minutes.

POST TEST PROCEDURES

- a. Remove impinger train from test assembly.
- b. Disconnect vinyl tubing from impingers.
- c. Measure the condensate collected in all four impingers in a graduated cylinder and record net amount collected.
- d. Disconnect desiccator unit. Weigh and record net weight increase.

B. PARTICULATE TRAIN PER EPA METHOD 5

PRE TEST PROCEDURES

- Add 100 ml. deionized-distilled water to each of the first two impingers of each train.
- Interconnect the four impingers of each train with pre-cut 16-inch lengths of vinyl tubing.
- c. Weight desiccator unit, and record weight.
- d. Attach desiccator unit to last impinger of the train.
- e. Add water and ice to impinger case.
- f. Connect vinyl line between desiccator unit and umbilical line.
- g. Select filter assembly and record filter disc serial number for each run.
- h. Select sampling probe. Record pitot tube number and Cp factor. Attach nozzle to probe.
- Insert filter assembly in filter heater box and attach both to sampling probe.
- j. Attach Teflon-lined vinyl tubing between filter assembly and first impinger of train.
- k. Attach pigtail to umbilical connector and filter box.
- 1. Leak check completed train assembly.

POST TEST PROCEDURES

- a. Leak check train assembly on completion of test run.
- b. Disconnect desiccator unit, reweigh and record net weight increase.
- c. Remove nozzle from sample probe and rinse with acetone or deionizeddistilled water. Collect rinsings in a mason jar.
- Rinse probe with acetone or deionized water. Collect rinsings in a mason jar.

- e. Run probe cleaning brush through sample probe.
- f. Rinse brush and re-rinse probe with acetone or deionized_distilled water. Repeat until clean. Collect rinsings in a mason jar.
- g. Record test run serial number on mason jars.
- h. Rinse Teflon-lined vinyl tubing with methylene chloride and collect rinsings in a mason jar separate from probe rinsings. Record test run serial number on jar.
- Remove filter assembly from heater box and return to filter carrying case.

C. CO2, O2, AND CO GRAB SAMPLES PER EPA METHOD 3

- 1. Identify each scotch-pak bag with test run serial number.
- Connect Teflon-lined flex hose to stainless steel probe.
- 3. Attach free end of flex hose to condense.
- 4. Connect condenser to vacuum side or pump with 1/4" O.D. Teflon tubing.
- 5. Connect Teflon line between vacuum pump and sample bag.
- After purging sample lines with sample gas, connect bag and fill until 2/3 full.
- D. NOX GRAB SAMPLES PER EPA METHOD 7

PRE TEST PROCEDURES

- a. Identify each 2-liter flask with test run serial number.
- b. Mix absorbing solution 6 ml. of 3.0% $\rm H_2O_2$ to 1 liter of $\rm H_2SO_4$ solution.
- c. Pipette 25 ml. of absorbing solution into each flask.
- d. Evacuate each flask and turn flask valve to purge position.
- e. Using same test setup as in Section C, connect flask between condenser and the vacuum pump.
- f. After allowing system to purge, open flask valve to sampling line to draw in sample.

POST TEST PROCEDURES

- a. Turn flask valve to purge position.
- b. Disconnect flask from sample line and shake flask for 5 minutes, then place in carrying box.

E. SO2 TRAIN PER EPA METHOD 6

PRE TEST PROCEDURES

- a. Mix an 80% solution of iospropanol.
- b. Dilute 30% H₂O₂ to 3.0% by adding deionized distilled water, 1:9.
- c. Add 15 ml. of 80% isopropanol to the midget bubbler of each train.
- d. Add 15 ml. of 3.0% $\rm H_2O_2$ to the second and third impinger of each train.
- e. Interconnect the one bubbler and four impingers with glass connectors.
- f. Connect single desiccator unit to the last impinger of each train.
- g. Connect probe with sampling line to bubbler.
- h. Add ice and water to midget impinger case.
- Connect the desiccator unit to stack-sampler console with an appropriate length of 3/8 inch vinyl tubing.
- j. Leak check completed assembly.

POST TEST PROCEDURE

- Disconnect probe and sample line from impinger train. Attach an MSA filter cartridge to bubble and purge train for 15 minutes.
- b. Disconnect impinger train after purging.
- c. Discard contents of midget bubbler and first impinger.
- d. Collect contents of midget impingers in prescription bottles.
- Rinse each impinger and connecting tubes with deionized-distilled water and add rinsings to sample bottle.
- f. Seal bottle and label with test run serial number.

F. HYDROCARBON GRAB SAMPLES

- 1. Identify each double-ended flask with test run serial number.
- Using same test setup as Section C, connect flask between the condenser and the vacuum pump.
- Open both flask valves, and purge the flask with sample gas for 2 minutes.
- After purging, close the downstream valve first, then close the upstream valve trapping the sample in the flask.



Appendix G

Suggested Forms for Recording Source Test Data



G - 1 STATE OF CALIFORNIA AIR RESOURCES BOARD

SOURCE TEST REPORT

Stationary Source Control Division ENGINEERING EVALUATION BRANCH REPORT NO.

Project Engineer

Approved:

, Chief

Engineering Evaluation Branch

Approved: ·

, Chief

Stationary Source Control Division



SUMMA RY	1
Project engineer	Report number
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Address	
Telephone number ()	
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company representative(s)	<u>Title(s)</u>
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Form of request	Date of request
Reason for request	
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ii

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Comparison Between Allowable and Measured Emissions

Air pollution Control District

1

 Rule
 Emissions

 Number
 Title

 Allowable
 Measured

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II. Test Results
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B. Field Notes and Data Sheets
C. Summary of Test Data and Calculations
D. Maps

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State of California

AIR RESOURCES BOARD

Source Test Report

I. INTRODUCTION

The Air Resources Board staff conducted a source test at_____

on the dates of_____

All witnesses to the test are identified in Table I.

Table I

Source Test Witnesses

Nawe	Title	Affiliation
nan da kan da		

During the testing the staff evaluated emissions from



The purpose of the source test was to______.

Any other prior source tests conducted at

are summarized in Table II.

Table II

Prior Source Tests (if any)

Item tested	Organization performing test	Date of test	ARB report number (if applicable)
The complete mile of a solution displayed and solution of the conservation			

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II. TEST RESULTS

Table 111

Source Test Results

APCD	Rule aumber	Allowable Emissions	Measured emissions	
Test number			Average	
Date of test				
Duration of test, minutes				
Process weight rate, lbs/hr				
Gas flow rate SCFM (DRY)				
Stack gas temp.				
CO2 % by volume				
0 ₂ % by volume				
CO % by volume				
H ₂ 0 % by volume				
Particulate concen- tration, gr/scf				
Particulate weight, lbs/hr				
Combustion contami-				
Dilution factor (calculated)				
NOX' bbu.				
NOx, 1bs/hr				
S02, ppm*				
SO2, 1bs/hr				

"Corrected to _____ percent excess air.

Reviewed by____

Approved by____

Manager, Testing Section

3

REMARES CONCERNING MEASURED EMISSIONS

3

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and the second se

III. PIANT DESCRIPTION

•

PRODUCT(S) MANUFACTURED OF SERVICE(S) PROVIDED

•

PLANT CAPACITY (1bs/hr, MW, etc.)

PROCESS DESCRIPTION

Figure I

Flow Schematic

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V	TEST METHODS					
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V. TEST CONDITIONS

PLANT OPERATING CONDITIONS

Process weight (include source's strip chart if available):

Operating at _____ percent of capacity.

.

Other comments:

Results of stack flow check for turbulent and cyclonic conditions:

Table IV

Weather Conditions

Date :	Time	Barometric Pressure	Temperature

.






Table V

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Traverse Point Computations

Traverse	% of	Distance of inside diameter						
point	inside diameter	Point A to sample port 1	Point B to sample port 2	Sample port 1 to point A	Sample port 2 to point B			
Description de la comme de la comme								
			•					
	3							
			1					

Figure III



BY. A.C. DATE	SUBJECTSAMPLING PORT LOCATION	SHEET NO.
CHKD. MY T.M. DATE		JOB NO.



____OF____





AQCEE-1024 10/7

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Date

State of California

AIR RESOURCES ECAND

Stationary Source Control Division Engineering Evaluation Branch

SO2 SAMPLING TRAIN DATA

Run No	Ambient Temp. P				
Location	Ear. Press. In. Hg.				
Sample Station	Operator				
Meter No.	Special Instructions				

CLOCKTIME	METER VOLUME (FT3)	METER TEMP (°F)	VACUUM (IN. HG.)	SAMPLING RATE (CFM)	RCTA- METER
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	-				
an a					

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AIR RESOURCES BOARD

Stationary Source Control Division Engineering Evaluation Branch

VELOCITY TRAVERSE DATA

Traverse Point Number	Velocity Head in, H ₂ O	Distance from inside wall (in.)	${f Temperature} \ {f (T_S), {}^{\circ}F}$	Velocity Head in. H ₂ O	√∆P	Stack Temperature $(\underline{T}_S), {}^\circ F$
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Average						
Plant		• .		Pitot T	ube Factor	timm anan alina unya ajina alina man
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Barometric	Pressure, i	.n, Hg		8		
Static Pre	essure in Ste	ck (P_g) in. H	°			
Operators	a more the unit 1.17 - a gain groups	Date	 Notice to an address of the contract of the contr	4:		

State of California File No.

AIR RESCURCES BOARD

Stationary Source Control Division Engineering Evaluation Pranch

VELOCITY AND FLOW RATE CALCULATIONS

A. Stack Gas Molecular Weight (Mg)

Component	Volume % /100	Factor (1-Bwo)	Molecular Weight of Component	Vol % X Factor X H _{Sn}
H ₂ O (Vol. %)		1.0	18	
COp			44	
02			32	at 199
CO			28	
Nz			28	
			M _S =	

B. Stack Area (As)

A_S = A_s = ____

C. Stack Velocity (VS)

$$v_{s} = 85.48 \ c_{p}(\sqrt{\Delta P})_{avg} \sqrt{\frac{T_{s}}{P_{s} M_{s}}}$$

 $v_{s} = 85.48()()()/(())/(()) = ----f_{ps}$

DIEEE 1040 7/73







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12 Equal Areas Half Annuli

FIGURE III-3

~

CROSS SECTION OF CIRCULAR STACK DIVIDED INTO 12 EQUAL AREAS WITH A TRAVERSE POINT AT THE CENTROID OF EACH AREA



FIGURE III-4

CROSS SECTION OF RECTANGULAR STACK DIVIDED INTO 12 EQUAL (RECTANGULAR) AREAS, WITH A TRAVERSE POINT AT THE CENTROID OF EACH AREA

G - 21

						1 - Inc In							1
Traverse point number on a diameter	2	4	Num 6	ber of 8	trave	rse po 12	ints o	n a di 16	ameter 18	20	22	24	
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	14.6	6.7 25.0 75.0 93.3	4,4 14.7 29.5 70.5 85.3 95.6	3,3 10.5 19.4 32.3 67.7 80.6 89.5 96.7	2.5 8.2 14.6 22.6 34.2 65.8 77.5 85.4 91.8 97.5	2.1 6.7 11.8 17.7 25.0 35.5 64.5 75.0 82.3 88.2 93.3 97.9	1.8 5.7 9.9 14.6 20.1 26.9 36.6 63.4 73.1 79.9 85.4 90.1 94.3 98.2	1.6 4.9 8.5 12.5 16.9 22.0 28.3 37.5 62.5 71.7 78.0 83.1 87.5 91.5 95.1 98.4	1.4 4.4 7.5 10.9 14.6 18.8 23.6 29.6 38.2 61.8 70.4 76.4 85.4 85.4 89.1 92.5 95.6 98.6	1.3 3.9 6.7 9.7 12.9 16.5 20.4 25.0 30.6 38.8 61.2 69.4 75.0 79.6 83.5 87.1 90.3 93.3 93.3 95.1 98.7	1.1 3.5 6.0 8.7 11.6 14.6 18.0 21.8 26.1 31.5 39.3 60.7 68.5 73.9 78.2 82.0 85.4 88.4 91.3 94.0 96.5 98.9	1.1 3.2 5.5 7.9 10.5 13.2 16.1 19.4 23.0 27.2 32.3 39.8 60.2 67.7 72.8 77.0 80.6 83. 86.5 92.1 94.5 96.8 98.9	

TABLE III-1: LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

(Precent of stack diameter from inside wall to traverse point)

File No.

AIR RESOURCES BOARD

State of California

Division of Implementation & Enforcement Engineering Evaluation Unit

WATER VAPOR CALCULATIONS

Standard Conditions 60°F and 29.92 in. Hg

Ambient Conditions ____ oF and ____ in. Hg

Time	Gas Volume Through Meter (Vm), Ft ³	Impinger Temp. (Ti), °F	Meter Temp. (Tm), °F	Orifice Pressure (Ah),in. H ₂ O	Volume of Water Collected in Impinger (V _{lc}), ml
					Final Initial
		}			
					Net (V _{le})

A. Gas Volume Metered (Vmstd)

$$P_{ma} = P_{bar} + (\Delta H/13.6) = () + (\frac{}{13.6}) = -$$
 in. Hg

$$V_{mstd} = \frac{520 \text{ °R}}{29.92 \text{ in. Hg}} \cdot \frac{V_{m} P_{ma}}{T_{m}} = (17.38) () () = - S \text{ DCF}$$

$$V_{Wstd} = (0.0464 \frac{Ft^3}{ml}) (V_{lc}) = (0.0464) () =$$
_____SCF

C. Volume of Water Vapor at Impinger Temp (VwVstd)

V. P. = in.
$$Hg at T_i =$$
 °F

$$V_{WV_{std}} = \frac{\left(V_{m_{std}}\right)\left(V.P.\right)}{\left(P_{ma} - V.P.\right)} = \frac{()}{()} = \frac{()}{()}$$

D. Moisture Content in Stack Gas (Bwo)

 $B_{WO} = \frac{B + C}{A + B + C} = \left(\frac{1}{C} \right) = \frac{1}{C}$ E. Moisture Content at Saturation at T_S of <u>____</u> o_F

 $B_{WO} =$ _____. Use E if D > E.

APPENDIX IV-2

SATURATION VAPOR PRESSURE OVER WATER CURVE





APPENDIX IV-3

PSYCHROMETRIC CHART FOR AIR-WATER VAPOR MIXTURES

(AT 29.92 IN. HG.)

G - 25

								Pomach Pomach F	547.														
				Stack Press In. Hg	NOC LABER																		
	P OF	hIg	sture %	Setting, ^o F	1a., In.	h	r Setting	Impinger ^{Temp} oF															
	Ambient Tem	Bar. Press.	Assumed Mol	Heater Box	Probe Tip D	Probe Lengt	Probe Heate	Pump Vacuum In. Hg Gauge															
TA			I IN ALL BLANKS	the start of	After	1		Dry Gas Temp. Inlet Outlet															
FIELD DA			PORTANT - FI	d record at t	st point.		ube Factor	H ₂ O H Actual															
			VERY IM	Read an each te Leak Te Pitot T			Pitot T	Orifi Desired															
								Pitot in. H20 A P															
																				ox No.	ox No.	Dry Gas Meter, CF	
		Run No.	Locatio	Date	Operato	Sample	Meter B	Clock Time															
								Point															

G - 26

\sim								Steck Steck	
				E.				Stack Press In. Hg	
	ap °F	3H".	isture %	Setting.	Dia., In.	th	er Setting	Impinger Temp oF	
	Ambient Te	Bar. Press	Assumed Mo	Heater Box	Probe Tip 1	Probe Leng	Probe Heat	Pump Vacuum In. Hg Gauge	
DATA			N ALL BLANKS	start of				Gas Temp. OF ot Outlet	
S FIELD			TILL I	at the				Dry	
ANIC /			TNATAOT	nd record	6			ce AH 1 H20 Actual	
ORG			VERY II	Read an each te				Orif ¹ ir Desired	
				-				Fitot in. H20 & P	
			uo		or	Box No.	Box No.	Dry Gas Meter, Cr	
	4	Run No	Locati	Date	Operati	Semple	Neter 1	Clock Time	
\cap						q		Point	

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File	$\mathbb{N}^{\bigcirc r}$	
Date		

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SO2 SAMPLING TRAIN DATA

Run No.	
Location	and the second
Sample Station	
Meter No.	

Ambient	Temp. OJ	<u></u>	
Bar. Pre	ss. In.	Hg.	
Operator	3		
Special	Instruct	tions	

· .

CLOCKTIME	METER VOLUME (FT ³).	METER TEMP (°F)	VACUUM (IN. HG.)	SAMPLING RATE (CFM)	ROTA- METER
	ر ». •				
		•			•
				•	
and the second				• •	and for the second s
			•		

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Llj:	10.
nute	

Stationary Source Control Division - Engineering Evaluation Branch CHIDES OF NITEGER AS NO2 - CALOULATIONS

The dry volume of stuck gas compled is colculated as follows:

- $v_{ag} = \frac{(v_f v_a) (p_f p_{H_20})}{29.92 r_f}$
- $v_{dg_1} = \frac{17.38}{()}$
- Vdg1
- $v_{dg_2} = \frac{17.33}{()}$
- Vdg2 = _____

- The calculations for oxides of nitrogen concentrations on a dry basis take use of the relation
- $(c_{\text{NOX}})_{d} \approx 515 \frac{W_{\text{NOX}}}{V_{dg}},$ $(c_{\text{NOX}})_{d_{1}} \approx 515 \left\{--\right\},$ $(c_{\text{NOX}})_{d_{1}} \approx 215 \left\{--\right\},$ $(c_{\text{NOX}})_{d_{2}} \approx 515 \left\{--\right\},$ $(c_{\text{NOX}})_{d_{2}} \approx 215 \left\{--\right\},$

(cROE) dave = ____ pper

where,

25

а.

25

- Vdg = volume of dry stack gas samples, . milliliters at standard conditions (60 F, 14.7 psia)
- V_f = volume of sampling flask, milliliters
- Va = volume of absorbing Bolution milliliters
- Fig0 = vapor pressure of water at temperature Tr, inches of mercury
- Tr = temperature in flask, degrees Rankine

where,

- W_{NOX} = weight of nitrogen diexide, from the calibration curve, micrograms
- Vdg = dry volume of gas sample, milliliters

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G - 31 VISIBLE EXISSIONS-FIELD EVALUATION RECORD

Company								Dat	te _	esperies, sing	6
Location						•		-			and which the state of the stat
Observer	•					•		11	me St	art	01120 (1010-17) (1010-1010)
Sky Cond	itio	n						111	us St	op _	
Wind Sne	ed				NPH Dire	etion					
HANG OF					Call 14 grava ~						
Air Temp	erat	ure			°F Rela	tive Mun	idity			-	
Plume Ch	arac	teris	tics	(Cold	or, Etc.)		in the second second				
Stack He	ight	-		Fee	t Observer	Locatio	n		Peet	t	of stack.
											-
Monto	0	7/);	1/2	2/1	- · ·	Manta	0	3/11	1/2	2/1	Remarks
0	0	1/4	1/2	3/41	REALTAB	20		<u>[]</u>		1.51.4	
1					•	31			1		
2						32		1			
3						33					
4					1. E. E.	34		1			
5					. •	35					
6						36					
7						37					
8						38					
9				-	· .	39			1		
10						140					
11						41					
12						42					
13						43					
-74						4,4					-
1.5					•	45					
16						40					
19						1.8		1			
10						. ho		1			
20						50			1		
21		1				51					
22		İ				52					
and the second se						53					
23		strength when appendice in such that								1	
23 24						54					4
23 24 25						<u> </u>					
23 24 25 26						<u>59</u> <u>55</u> <u>56</u>					

Vapor Recovery System Data Sheet

COMPANY:		DATE	• 	
ADDRESS:	2	BAR.	PRESS:	
ITEM TESTED:		DROP	VOLUME:	

Vent Delivery Tank Remarks Meter Reading (Ft3) Pressure (inch of H₂0) Pressure (inch of H₂0) Clock Clock Vapor Temp (°F) Time Time . 4

EMISSIONS

FIXED ROOF TANK EMISSION OBSERVATION SHEET

GENERAL INFORMATION	OBSERVER
OWNER:	LOCATION
OPERATOR:	TANK NO.
PLANT PERSONNEL CONTACTED:	PERSONNEL CONDUCTING TEST:
DATES OF OBSERVATION:	
MODE OF TANK DURING TESTING: STANDING	WORKING
TANK PHYSICAL PARAMETERS 1. YEAR OF TANK CONSTRUCTION: MAN 2. COLOR OF TANK WALLS: Black White Lt.Gra	UFACTURER:
Aluminum (Specular) 3. COLOR OF TANK ROOF: Black White Lt.Gra Aluminum (Specular)	Aluminum (Diffuse) Aluminum (Diffuse)
 4. PAINT CONDITION: POOR GOOD 5. INSULATION: YES NO THICKN 6. COATING OF INSIDE TANK WALL, IF ANY: 	NESS: INCHES
7. COATING OF ROOF (OUTSIDE), IF ANY: 8. HEIGHT: (STRAIGHT WALL) 9. DIAMETER: FEET INCHES 10. TANK TYPE: WELDED RIVETED	FEETINCHES .
10. TANK TITE: WEBBAB 11. CAPACITY OF TANK: BBLS 12. ROOF SLOPE: INCHES/FEET 13. INTERNAL HEATERS: YES NO 14. VAPOR RECOVERY SYSTEM: YES NO	F YES: STEAM HOT WATER
15. PRESSURE/VACUUM ROOF VENTS: TYPE	RMAL SETTINGS IN H20 VACUUM IN H20 PRESSURE RMAL SETTINGS IN H20 VACUUM IN H20 PRESSURE IN H20 PRESSURE
16. GENERAL CONMENTS THAT MAY RELATE TO H-C E	MISSIONS:

ALL TANK OPERATIONS

- 1. NAME OF CRUDE:
- 2. OIL FIELD:

(IF THE TESTED TANK CONTAINED DISTILLATE OR FUEL OIL, INDICATE NOT APPLICABLE ON 1 AND 2.)

- 3. IF TANK WAS NORMALLY ON VAPOR RECOVERY, HOW LONG WAS VAPOR RECOVERY DIS-CONNECTED PRIOR TO TEST? HOURS
- 4. IF THERE WAS AN INTERNAL TANK HEATER, WAS IT OPERATING DURING THE TEST? YES_____NO_____
- ANALYSES THAT WERE PERFORMED ON LIQUID SAMPLES OBTAINED WITHIN 1 WEEK OF THE TEST DATES (E.G. API GRAVITY, REID VAPOR PRESSURE, ASTM DISTILLATION)

STANDING TANK OPERATIONS

1. DESCRIBE THE OPERATION OF THE TESTED TANK DURING TESTING. INCLUDE INFORMA-TION ON STOCK DEPTHS AND HOW IT CHANGES.

 DESCRIBE IMMEDIATE UPSTREAM OPERATIONS AHEAD OF THE TESTED TANK. INCLUDE THE OPERATING TEMPERATURE AND PRESSURE OF THE UPSTREAM UNIT. EXAMPLES OF UP-STREAM OPERATIONS COULD BE A HEATER TREATER UNIT, IN-LINE HEATER OR A STORAGE TANK. 3. PROVIDE A SIMPLE PROCESS SCHEMATIC OF THE TESTED TANK AND PROCESS OPERATIONS IMMEDIATELY UPSTREAM. AN EXAMPLE IS SHOWN BELOW. THE SCHEMATIC SHOULD SHOW THE SYSTEM USED DURING THE TEST. SHOW LOCATION OF VAPOR SAMPLING POINTS AND WHERE LIQUID SAMPLE WAS OBTAINED.



4. INDICATE ANY PROCESS CHANGES MADE SPECIFICALLY FOR THE EMISSION TEST WHICH WOULD BE DIFFERENT FROM NORMAL OPERATIONS.

 WAS A TANK LEAK CHECK PERFORMED: YES NO
WAS A TANK LEAK CHECK FERFORMED. TES NO
RESULTS
EMERGENCY RELIEF VALVE SETTING AND NUMBER DURING OBSERVATION:
MAXIMUM PRESSURE OF TANK DURING OBSERVATION:
DESCRIBE POTENTIAL SAFETY HAZARDS:
WERE THESE REPORTED TO PLANT PERSONNEL: YES NO WHO WAS IT REPORTED TO:
HYDROCARBON ANALYZER USED DURING THE OBSERVATION (NAME AND MODEL NUMBER):
DESCRIPTION OF CALIBRATION PROCEDURE (TIME, SPAN GAS AND CONCENTRATION, ZERO DRIFT, ETC.).
DESCRIBE VAPOR GRAB SAMPLES COLLECTION DURING OBSERVATION.
WAS AN OVA ANALYZER USED BY THE OBSERVER TO CHECK THE HYDROCARBON CONCENTRALD YES NO RESULTS AND COMPARISON WITH TEST RESULTS.
-

7.	COMMENTS RELATING TO MEASURING HYDROCARBON CONCENTRATION.	(LEAKS,	CON-
	DENSATION, ERRATIC RESPONSE, ETC.)		

8. DESCRIBE LIQUID LEVEL CHANGES, LIQUID FLOW RATES AND THROUGH-PUT INFORMATION DURING OBSERVATION.

.

9. DESCRIBE VAPOR FLOW RATES AND TEST METERING. -

•

10. DESCRIBE THE LOCATION AND MANNER IN WHICH LIQUID SAMPLE WAS OBTAINED.

11. IF TANK WAS PREVIOUSLY TESTED BY ENGINEERING-SCIENCE OR OTHERS, LIST THE PREVIOUS TEST RESULTS. CURRENT TECT (IF AVAILARIE)

STOCK PARAMETERS:		PREVIOUS TEST	CURRENT TEST	(IF AVAILABLE
	TEMP (°F)			
	RVP (LES)			
	GRAVITY (°API)			
	BBLS/DAY (IN)		derman photo	
	BBLS/DAY (OUT)		Bendgaran dagata ang kang dang pang kang panang mang bang pang kang kang kang kang kang kang kang k	
VAPOR DISCHARGE (S	CF/DAY)		Branch Constant of the second s	
AVG. MOLECULAR WT	(LB/LB-MOLE)			
METHANE CONCENTRAT	ION (LB/1000 SC	F) .		
THE CONCENTRATION	(LB/1000 SCF)	******		
METHANE EMISSIONS	(LES/DAY)	Name and the state of the state	والمحمد	
THC EMISSIONS (LBS	/DAY)			

2.	REMARKS:

SIGNED

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File No.

Program 002 Print Out (Particulate Source Test)



 $(/\Delta P)_{av} = (in. H_2 0)^{1/2} \chi Cp$ $D_s = Stack diameter (in.)$ $V_s = Velocity (fps)$ $Q_s = Flow rate, dry basis (SDCFM)$

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

 M_n = Particulate matter collected (mg) C' = Particulate concentration, dry bacis (gr/SDCF) W_m = Particulate emission rate (lb/hr.)

 $V_{MSD_c} = Std.$ volume of dry gas metered (cu. ft.) $V_{WSD_c} = Std.$ volume of water vapor collected (cu. ft.) $V_*P_{**} = Vapor \text{ pressure (in. Hg)}$ $V_{WVD_c} = Std.$ volume of water vapor metered (cu. ft.) $S = \% H_2O$ (includes free water)

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G - 40 State of California

File No.

AIR RESOURCES LOAND

Stationary Source Control Division - Engineering Evaluation Branch

SUMMARY OF EMISSIONS TO ATMOST HEFE

NAME OF FILM:	
LOCATION:	
DEDCRIPTICA OF OPERATION:	
STANDARD CONDITIONS:	-
ITHN TESTED:	

	Rule No.	 Reasoned Fore offic			Allowable
Tent No.		 		Average	Emissions
Date of Test		 			-
lamition of Test, minutes		 		· · · · · · · · · · · · · · · · · · ·	
Process Weight Pole, 155/hr		 			
Gar Fior Pate, SCFM (DRY)		 			
Stark Can Temp., 07		 			
CO2 7 by Vol.		 			
G, \$ 18 Vol.					1
Co S by Vol.					
H ₂ .0 % by Vol.					4
Particulate Concentration, pr/sef		 			
Particulate Weight, 1bs/hr		 			
Contaction Contactinants, pr/sef		 			
		 -			
		 	-		
		 1. (1. (1. (1. (1. (1. (1. (1. (1. (1. (1		
		 			10 A.M. (8 1 & C.M.) 1 (1) A
		 	1.11.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1		

CO1902(13)

Project Engineer_____ Checked by

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AIR RESOURCES BOARD

File No.

Stationary Source Control Division Engineering Evaluation Branch

SUTTARY OF TEST DATA

terial Collected:			
	P		
	Test //1	Test #2	Test #
P _{bar} , Barometric Piessure, in. Hg			
Ahavg, Average Orifice Pressure, in. H20		8	
Vm, Earple Gas Volume (Mater Cond.), cu. ft	6r		
\mathbb{T}_m , Average Meter Temperature, $^{\mathrm{O}}\mathrm{F}$			
V _{we} , Condensed Water Vapor, ml.			
T _i , Average Impinger Temperature, ^o F			
P _s , Average Stock Temperature, ^o F			
Stack Gas Abalysis (Dry Basis)			
% C0	2	viel 17 w Hard V Mandragen, 19 - Nathrad Mittle Vanna anglise, Ny magazina	
% (5		•
% C(
(VAP) Average (in. H ₂ O)" X CP			
D _s , stack plameter, in.			
G, Sampling Time, min.			
D _n , Sampling Rozzle Diameter, in.			
n, Sample Weight Collected, ng.	1.		
I	3.		
· · ·			
1).		and an all of the share of the same of the
Total Weight, mg			
C _p , Pitot Tube Coefficient			
$P_{\rm e}$, Stack Pressure (absolute) in. H _C			
T _n , Ambient Temperature, ^O P			
Additional Data	b		

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State of California

AIR RESOURCES BOARD

SO2, Aldehyde, Organic Acid Calculations

File	No.	6 94. Automotive control a descent of the large of the control of the large of the
Date:	_	Andrews war at the Physical contract part devices many and

Standard Conditions: 60°F, 29.92 in Hg. Vm Std. = Gas Volume sampled at standard conditions

Sulfur Dioxide

$$\begin{split} & W_{\rm S} = \text{Weight Collected (mg)} \underbrace{\qquad}_{\text{M}} V_{\rm m} = \underbrace{\qquad}_{\text{cu. ft.}} cu. \text{ ft.} \\ & V_{\rm m} \text{ std.} = 17.38 \ V_{\rm m} \left(\underbrace{\begin{array}{c} \text{Pbar} + \underline{\Lambda H} \\ 13.6 \end{array} \right)}_{\text{Tm}} = 17.38 \ (\) \left(\underbrace{\begin{array}{c} \end{array} \right)}_{\text{()}} = \underbrace{\qquad}_{\text{scf}} \\ & concn. = \underbrace{836 \ (W_{\rm S})}_{(V_{\rm m} \ \text{Std.})(M)} = \underbrace{13.06 \ W_{\rm S}}_{V_{\rm m} \ \text{Std.}} = \underbrace{\qquad}_{\text{ppm}} \text{ (Vol.)} \end{split}$$

Organic Acids (as acetic acid)

$$W_{\rm S} =$$
_____ mg . $V_{\rm m} =$ _____ cu. ft.
 $V_{\rm m}$ Std. = 17.38 $V_{\rm m}$ $\left(\frac{{\rm Pbar} + {\Delta {\rm H}} {13.6}}{{\rm T_m}}\right) = 17.38$ ()) $\left(\frac{1}{1000}\right) =$ _____ scf

Concn. =
$$\frac{13.93 \text{ Ws}}{7_{\text{m}} \text{ Std.}}$$
 = $\frac{13.93 \text{ ()}}{\text{()}}$ = _____ ppm (Vol.)

Aldehydes (as formaldehyde)

$$V_{\rm S} =$$
 mg $V_{\rm m} =$ cu. ft.

$$V_{\rm m} \, {\rm Std}_{\circ} = 17.38 \, V_{\rm m} \, \left(\frac{{\rm Pbar} + \frac{\Delta \, {\rm H}}{13.6}}{{\rm T}_{\rm m}} \right) = 17.38 \, () \, \left(\right) \, \left(\right) = \underline{\rm scf}^{\circ}$$

Concn. =
$$\frac{27.87 W_s}{V_{\rm H} \, \text{std.}} = \frac{27.87 ()}{()} =$$
 ppm (Vol.)

Appendix H



APPENDIX H

METHOD 6 CHECKLIST TO BE USED BY AUDITORS

OPERATION PRESAMPLING PREPARATION

YES	NO	COMMENT		
	· ······		1.	Knowledge of process conditions
			2.	Calibration of pertinent equipment, in particular the dry gas meter and rotameter, prior to each field test.
				ON-SITE MEASUREMENTS
	·	al-and a statement of a statement of the statement of the	3.	Leak-testing of sampling train after sample run
		******	4.	Preparation of absorbing solution and its addition to bubblers and impingers
C. Sectors			5.	Constant sampling
	Antopolita and	Andrew Providence of the State of State	6.	Purging of the sampling train and rinsing of the impingers and connecting tubes to recover the sample
			7.	Recording of pertinent process condition during sample collection
			8.	Maintaining the probe at a given temperature
				POST SAMPLING
	-	-	9.	Control sample analysis - accuracy and precision
			10	Sample aliquotting techniques
		1	11.	Titration technique, particularly endpoint precision
]	12.	Use of detection blanks in correcting field sample results
		1	3.	Calculation procedure/check
	······	1	4.	Calibration checks
		1	.5.	Standardized barium perchlorate solution

GENERAL COMMENTS

H-2

METHOD 5 CHECKLIST TO BE USED BY AUDITORS

YES	NO	OPERATION
		EQUIPMENT PREPARATION AND CHECK
		1. Sampling train assembled and leak checked.
-		2. Probe and filter box heaters checked and set for proper
		temparatures.
		3. Stack gas temperature measuring system assembled and
		checked for proper operation by comparing to a mercury
		in glass thermometer.
	-	4. Stack gas velocity measuring system assembled and checked
		for proper operation.
		5. Orsat analyzer assembled and checked.
		PRELIMINARY MEASUREMENTS
		6. Selection of traverse points according to Method 1.
		7. Moisture content by Method 4, or equivalent.
		8. Molecular weight by Method 3, or equivalent.
		9. Measurement of stack dimensions.
		10. Mark probe for sampling at traverse points.
		SAMPLE COLLECTION
		 Equal sampling time at each traverse point.
		12. Probe temperature satisfactory throughout the test.
		13. Filter box temperature 120 ± 14°C (248 ± 25°F) through the test.
		14. Sample gas temperature at last impinger $pprox$ 20°C (68°F) through-
		out the test.
		15. Isokinetic sampling checked and adjusted if necessary
		at least every 5 minutes.
		16. Leak check of sampling train at end of test.
		SAMPLE RECOVERY
		17. Satisfactory handling and movement of probe and filter
		to sample recovery area.
		18. Recovery area satisfactory (i.e., space, cleanliness,
		etc.)

METHOD 5 CHECKLIST TO BE USED BY AUDITORS (continued)

YES	NO	OPERATION
		19. Sample recovery procedure adequate.
		20. Proper labeling of sample containers.
		21. Determination of moisture content procedure adequate.
		ANALYSIS
		22. Proper equilibration of (1) filter, (2) probe wash
		residue, and (3) acetone blank residue.
		23. Correct collected particulates for acetone blank.
		24. Analytical balance checked before weighings.
		DOCUMENTATION
		25. All information recorded on data sheet as obtained.
		26. All unusual conditions recorded.

COMMENTS

METHOD 7 CHECKLIST TO BE USED BY AUDITORS

YES	NO	OPERATION
		PRESAMPLING PREPARATION
		 Information concerning combustion effluents which may act as interferents
		2. Plant operation parameters variation
		 Calibration of the flask and valve volume three determinations
1		4. Absorbing reagent preparation
		ON-SITE MEASUREMENTS
		5. Leak-testing and sampling train
		 Preparation and pipetting of absorbing solu- tion into sampling flask
		POST SAMPLING (ANALYSIS AND CALCULATION)
		7. Control sample analysis
-		8. Sample aliquotting technique
		9. Evaporation and chemical treatment of sample
	1	0. Spectrophotometric technique
		a. preparation of standard nitrate samples
		b. measurement of absorbance, including blanks
		c. calibration factor
		d. wavelength and absorbance, including blanks
	1	1. Calculation procedure and checks
		a. use of computer program
		b. independent check of calculations

COMMENTS

H-4

METHOD 8 CHECKLIST TO BE USED BY AUDITORS

OPERATION PRESAMPLING PREPARATION

YES	NC	COMMENT		
			1.	Knowledge of process conditions
			2.	Calibration of pertinent equipment, in particular, the dry gas meter, prior to each field test.
				ON-SITE MEASUREMENTS
			3.	Leak-testing of sampling train after sample run
			4.	Preparation and addition of absorbing solutions to impingers
		And a second	5.	Isokinetic sampling
		Verdeningen name	6.	Purging of the sampling train and rinsing of the impingers and connecting tubes to recover the sample
			7	Recording of pertinent process condition during sample collection
			8 .	Maintaining the probe at a given temperature
				POST SAMPLING
			9.	Control sample analysis - accuracy and precision
		1	Ο.	Sample aliquotting techniques
1411-1411-14		1	1.	Titration technique, particularly endpoint precision
*******		1	2 .	Use of detection blanks in correcting field sample results
		1	3.	Calculation procedure/check
		14		Calibration checks
		15		Standardized barium perchlorate solution

GENERAL COMMENTS


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APPENDIX J

Procedures for Leak Checking Source-Sampling Trains

I. Purpose

To ensure that the sample collected is representative of the source the sampling train must be leak free. All sampling trains used by or on behalf of California Air Resources Board (ARB) for the collection of any samples must be checked for leaks before and after each test. The following are some suggested procedures for performing these leak checks.

II. Assembling Train Components

At the testing site the sampling train components are assembled carefully to ensure that all connections are air tight and leak-free. All ground-glass ball and socket connections must be clamped together with positive-lock pinch clamps. A light coating of silicone grease is applied to the outer portion of the male ground-glass joints. If tygon rubber or teflon tubing is used for connecting inpingers or other components, the internal diameter of the flexible tubing should be one eighth of an inch-less than the outer diameter of the mating fixture.

Sampling equipment mounted in a mobil monitoring van is particularly vulnerable to vibrations. In this case all sample line connections should be rigid screw type, otherwise screw clamps which compress an airtight seal at all connections must be used.

Spring clamps and clips may not be used to secure connections on a mobil installation unless the items being connected are securely mounted or clamped in place so as to exclude the imposition of tension on the joint.

III. Leak Checks

Prior to use in the field individual train components (e.g., meters pumps) should be checked for internal leaks by applying air pressure. All leak checks of the assembled train or monitoring system must be performed at the test site. Both positive (pressure) and negative (vacuum) leak checks should be performed, if applicable. When the pump is located at the rear end of the train, the entire train is operated under a vacuum. Occasionally the pump is located immediately ahead of the dry gas meter in which case the sample lines, ahead of the pump are under vacuum and the section between the pump and meter is under positive pressure. The pressure portion of the train may easily be checked by the application of air pressure. For most applications the vacuum leak check is the primary check which must be performed on the assembled train.

- A. Leak checks are performed just prior to and immediately following the completion of each test. A vacuum leak check on an EPA type integrated sampling train should be performed as follows:
 - (1) Plug intake nozzle with an air tight stopper.
 - (2) Turn on the pump.
 - (3) Turn the coarse adjustment valve on the console (meter box) to the <u>off</u> position and open the fine-adjust valve until the vacuum gauge reads 15 inches of mercury. After the dial has stabilized, the flow rate should stop. If a flow rate in excess

of 0.01 cubic feet during 30 seconds is observed the leak or leaks must be found and corrected.

- (4) If the leak rate is found to be satisfactory, the plug is first slowly removed from the nozzle after which the pump is turned off. This procedure prevents water from the impingers from being forced backward into the filter.
- B. Grab Sampling Trains

Leak checks must be performed on all grab sampling trains before and after use. The leak checks must be performed at the test site.

The components are assembled carefully to ensure a leak-free assembly. During the leak test it is necessary to measure both the vacuum and the flow-rate. To facilitate frequent leak checks a special prefabricated panel including a rotometer and a sensitive vacuum gauge is included with each sampling train. To perform a leak check, this panel is inserted just ahead of the pump or aspirator. The sample probe inlet is plugged and air is slowly evacuated until a vacuum of one inch of mercury is reached. The bi-pass valve on the pump is opened slowly and the vacuum is adjusted so as to maintain a vacuum of one inch of mercury. After stabalization the vacuum must be maintained for a period of one minute. The sampling train configuration will dictate the type of leak test that has to be performed e.g., pressure leak tests must be performed on that portion of the train which will operate under pressure during the test. Leak checks shall be conducted in such a manner as to demonstrate effective leak-free performance of all connections, valves, sample lines and impingers through which the gas sample must pass before being measured by a meter.

IV. Records

The engineer or technician in charge must verify that he has performed or observed the leak test by completing and signing the appropriate Leak Test Record. A complete leak check record must accompany all field data.

(see attached)

LEAI	ΚT	EST	REC	CORD

Company:

Address:

The following leak checks were made on the sample train shown in the schematic.

Data	Timo	Press Start	sures Finish	Test Duration	Test Method	Was Standard (for method) Sampling Train Used	
Dale	1 me	111-H2U	111-H20	MINS.	140.	res	NO

SAMPLE TRAIN SCHEMATIC (Show Sample Lines, Valves, Connections, and Components)

Field Supervisor Sig	nature:			Project Number
Symbols and Abbreviations		VALVES		-
Connector Types: SL = Swage Lock HC = Hose Clamp	Line Types: T = Teflon SS = Stainless	FLASKS		
GT = Glass Taper (Clamper) GB = Glass Ball (Clamper) Other:	TYG = Tygon R = Rubber Other:	PUMP	SENSOR	T.C. = Thermocouple
		FLOW DIRECTIONS		TH = Thermometer
		MISC.		

