State of California
AIR RESOURCES BOARD

RESOLUTIONS

Resolutions -1983-

No.	Item	Staff	Hearing Scheduled	Date Adopted	+ EIS to Resources
83-1	Appointment of Dr. Alvin Gordon to the Research Screening Committee	Research	3/10/82	3/10/83	N/A
83-2	Guiding Principles Governing Relations Between the ARB and Local Air Pollution Control Agencies	RPD	3/10/83	3/10/83	N/A
83-3	Amendments to the Assembly-Line Test Pro. Regarding Quality Audit Sample Selection and Amend. to Title 13 Incorp. Test Pro.	MSCD	4/20/83	4/20/83	12/6/83
83-4	Amendments to Title 13 Regarding Exten- of the Date for Compli. with Class 111 ~~MC 1.0 g/km HC Exhaust Emiss. Std.~~	MSCD	4/20/83	4/20/83	5/5/83
83-5			Not Used	Not Used	N/A
83-6	Board Policy on Acid Rain Research Program	Research	4/21/83	4/21/83	N/A
83-7	Revisions to Ag. Burning Guidelines & the Meteorological Criteria for Regulation Ag Burning in Title 17	TSD	5/26/83	5/26/83	12/6/83
83-8	FY 1983-84 Subvention Criteria & Amendments to Subvention Regs.	RPD	5/27/83	5/27/83	12/6/83
83-9	Pacific Environmental Services "Assessment of Heavy-Duty Gas & Diesel Trucks in CA" $149,782	Research	5/26/83	5/26/83	N/A
83-10	UCD,"A Test Site for the Eng. Eval. of Toxic Airbone Effluents" $99,078	Research	5/26/83	5/26/83	N/A
83-11	"Emissions for Wood Stoves"	Research	6/29/83	Not Adopted	N/A
83-12	UCR: "The Effects of Present & Protential Air Pollution on Important San Joaquin Valley Crops" $124,894	Research	6/29/83	6/29/83	N/A
83-13	Draft Report to the CA Leg. on Air Pollutant Emissions from Marine Vessels	SSCD	6/29/83	No Resol. Necessary	N/A
83-14	Test Methods for Determining Compliance with District Nonvehicular Emission Standards.	SSCD	6/29/83	6/29/83	12/6/83
83-15	Regarding Visible Emissions from Certain U.S. Navy Steam Vessels	SSCD	6/29/83	6/30/83	12/6/83
83-16	Warranty of Emissions-Related Parts	MSCD	6/30/83	6/30/83	12/6/83

RESOLUTIONS

No.	Item	Staff	Hearing Scheduled	Date Adopted	+ EIS to Resources
~~83-17~~	Opitional 100,000 mile NOx Emission Std. for 1984 and Subsequent model Pass.	MSCD	6/30/83	No Resol. necessary Std.Affirm.	N/A
~~83-18~~	~~Farewell Resolution for James G. Leather~~	Legal	6/30/83	6/30/83	N/A
83-19	UCR-"Particulate & Gas Phase Mutagens in Ambient & Simulated Atmospheres" $160,000	Research	7/29/83	7/29/83	N/A
83-20	Johnson Matthey Inc.-"Optimization & Preformance of Trap Oxidizer for Part." $90,071	Research	7/29/83	7/29/83	N/A
83-21	Certifying in Califonia federally certified light-duty motor vehicles (AB 965)	MSCD	7/28/83	7/28/83	12/6/83
83-22	Acid Deposition fees to monitor & research data on acid deposition	Research	7/29/83	7/29/83	12/6/83
83-23	UCR- "Effects of SO2 on Growth & Yield of Winter Crops Grown in CA" $70,407	Research	8/26/83	8/26/83	N/A
83-24	1984 HD Engine Crankcase Emission Requirements	MSCD	8/25/83	8/25/83	12/6/83
83-25	Certificate of Complianace	MSCD	8/25/83	8/25/83	2/27/84
83-26	Amendments to toxic Regulations	OPPEC	8/26/83	No Resol. necessary	N/A
83-27	Lawrence Livermore Lab-"Pollutant Transport Study: BA to NCCA" $150,000	Research	8/26/83	8/26/83	N/A
83-28	Trap Oxidizer Systems for Diesel-Powered Cars	MSD	9/22/83	9/22/83	12/28/83
83-29	Energy Resources consultants-"Quantitative Assessment of the Effects of Not Controlling Air Poll. in CA.-Augm.$13,274	Research	10/27/83	10/27/83	N/A
83-30	SO2 State Ambient Standard	Research	10/27/83	11/18/83	12/28/83
83-31	Dr. L.S. Caretto Appreciation	Legal	10/27/83	10/28/83	N/A
83-32	Issuance of Permits under the Permit Reform Act of 1981	Legal	11/18/83	11/18/83	12/28/83

RESOLUTIONS

No.	Item	Staff	Hearing Scheduled	Date Adopted	+ EIS Resources
83-33	Report to the Legislature on Waste Incineration	SSD	11/18/83	12/16/83	N/A
83-34	NOX Offset from Volvo Proposal	MSD	Board took no Action	Will wait till Aug. 84 for Regs.	N/A
83-35	Cal Institute of Tech.-"The Evolution of Aerosol Loadidng During Wintertime Stagnation Epi. in S.J. Val." $53,000.	RD	12/16/83	12/16/83	N/A
83-36	UCI- "Effects of Short-Term Exposure to Co in Subjects with Coronary Artery Disease" $51,008.00	RD	12/16/83	12/16/83	N/A
83-37	UCR - Maintain & Operate CA ARBField Fumigation Facility for Experimental Use" $49,994	RD	12/16/83	12/16/83	N/A
83-38	Santa Fe Research Corp-"Development o methods ot Estimate the Benefits of Visibility Improvement" $9,855.00	RD	12/16/83	12/16/83	N/A
83-39	USC Med Center-"Correlative & Sensitive Discriminats for Air Quality control" $123,000.	RD	12/16/83	12/16/83	N/A
83-40	Cal Institute of Tech.-"A Study fo the Characteristics of Chimical Reaction Mechanisms for Photo Smog" 38,615.	RD	12/16/83	12/16/83	N/A
83-41	UCSF- "Effects of Oxone on the Asthmatic Airway" $169,860.	RD	12/16/83	12/16/83	N/A
83-42	Report to Legislature on Acid Deposition	RD	12/16/83	12/16/83	N/A
83-43	AB 965 Emissions Trading	MSD	12/15/83	12/15/83	
83-44	LPG or Natural Gas Fuels	MSD	12/15/83	12/15/83	
83-45	Report to the LIg. on NOx Retrofit	MSD	12/15/83	12/15/83	N/A
83-46	Resolution of Appriciation to John Doyle	Legal	12/16/83	12/15/83	N/A
83-47					
83-48					

State of California
AIR RESOURCES BOARD

Resolution 83-1

March 10, 1983

Agenda Item No.: 83-2-4

WHEREAS, THE Air Resources Board is vested, under Section 39705 of the Health and Safety Code, with authority to appoint a Research Screening Committee composed of up to nine members with expertise in specified technical areas;

WHEREAS, there now exist, as a result of resignations, two vacancies on the Research Screening Committee;

WHEREAS, Alvin S. Gordon, Ph.D., Professor of Engineering at the University of California, San Diego, is a recognized expert in research in the fields of chemistry and combustion;

WHEREAS, Dr. Gordon served with distinction as Chairman of the Research Screening Committee during his tenure as a Member of this Board; and

WHEREAS, Dr. Gordon has a full and complete understanding of the Board's research program and its importance to the Board's regulatory responsibilities;

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board hereby appoints to full membership in its Research Screening Committee the following person, who has been found to meet all of the requirements set forth in Section 39705 of the Health and Safety Code:

Alvin S. Gordon, Ph.D.
Adjunct Professor of Engineering
University of California, San Diego

I certify that the above is a true and correct copy of Resolution 83-1 as passed by the Air Resources Board.

Harold Holmes

Harold Holmes, Secretary

State of California
AIR RESOURCES BOARD

ITEM:	Appointment of a new member to the Research Screening Committee
RECOMMENDATION:	Adopt Resolution 83-1 appointing Alvin S. Gordon, Ph.D. to the Research Screening Committee.
SUMMARY:	Chairman Duffy has asked Dr. Alvin S. Gordon, former member of this Board, to serve as a member of the Board's Research Screening Committee; Dr. Gordon has agreed to serve. Dr. Gordon served as Chairman of the Research Screening Committee for the period 1976-1982, during his tenures as a Board Member and as a member of the Committee. Staff has reviewed Dr. Gordon's qualifications and determined that he is eminently well qualified under the provisions of Section 39705 of the Health and Safety Code for appointment to the Research Screening Committee.

STATE OF CALIFORNIA
AIR RESOURCES BOARD

Resolution 83-2
March 10, 1983

Agenda Item No.: 83-2-1

WHEREAS, the Legislature, in order to protect the health, safety, welfare, and sense of well-being of the people of California, declared its intent for an intensive, coordinated state, regional, and local effort to protect and enhance the ambient air quality of the state;

WHEREAS, the Legislature has charged the State Air Resources Board with the responsibility for control of emissions from motor vehicles and the responsibility to coordinate, encourage, and review the efforts of all levels of government as they affect air quality;

WHEREAS, the Legislature, having recognized the need for a regional approach to the problems of air pollution, vested in the local and regional authorities primary responsibility for control of air pollution from stationary sources of air pollution; and

WHEREAS, the responsibility for control of air pollution in California is shared among the state and local entities, it is in the best interest of the public that state and local air pollution control agencies work together to solve California's air pollution problems.

NOW THEREFORE BE IT RESOLVED, that the Air Resources Board recognizes the significant contribution of local air pollution control agencies to improved air quality in the state and the commitment of local agencies to carry out an effective air pollution control program.

BE IT FURTHER RESOLVED, that the Air Resources Board affirms its intent to work cooperatively with local air pollution control agencies to improve and maintain the quality of California's air, for the protection of the public health and welfare of the people of the state.

BE IT FURTHER RESOLVED, that the Air Resources Board through this resolution and the attached guiding principles reaffirms its support of local air pollution control agencies' activities and declares its intent to forge an even stronger state/local partnership, to build trust between the state and local air pollution control agencies, and to affirm the common goals of protecting the public health and welfare which bind together state and local air agencies.

BE IT FURTHER RESOLVED, that the Air Resources Board hereby adopts this Resolution and the attached "Guiding Principles Governing Relations Between the Air Resources Board and Local Air Pollution Control Agencies."

ATTACHMENT TO RESOLUTION 83-2

Guiding Principles Governing Relations Between the Air Resources Board and Local Air Pollution Control Agencies

This set of guiding principles is the foundation on which the Air Resources Board's interaction with local air pollution control agencies is based in fulfilling its obligation as the state agency charged with coordinating statewide efforts to attain and maintain ambient air quality standards. It is also the Board's intent in adopting these principles to affirm its desire to form an even stronger state/local partnership dedicated to managing an effective and efficient California air program to protect the public health and welfare of the people of California.

RESPONSIBILITIES

- The Air Resources Board affirms that local districts have the primary responsibility for the control of non-vehicular sources of air pollution. In fulfilling its obligation to coordinate and review air pollution control activities in the state, the Board will consider the districts' responsibility and will largely rely upon local districts as the air pollution authorities closest to the public to be responsible to the public for non-vehicular pollution control.

- The Air Resources Board, in its capacity as the responsible state agency for air pollution control in California, will review and comment on the activities of local districts and, where necessary, in accordance with law, take action to ensure the protection of the public health. However, in exercising its authority with respect to local district activities, the Air Resources Board will not act without full communication with the district affected.

INTERRELATIONSHIPS

- The Air Resources Board recognizes the importance of effective communication between state and local governments. To this end, the Air Resources Board endorses ongoing discussions with local districts to develop more effective mechanisms for improving cooperation and communication.

- To provide for continued understanding of issues at both the state and local levels, the Air Resources Board will, when invited, attend and participate in air basin and district meetings to the extent possible. The Air Resources Board also encourages testimony from local districts at Board meetings so that local district positions can be considered in Board decisions.

- To deal with issues and problems of mutual interest, the Air Resources Board will continue to participate, when invited, on CAPCOA and other district established committees and will invite CAPCOA/districts to participate on ARB established working groups.

- The Air Resources Board recognizes that problems and issues will arise that may result in differences of opinion between state and local agencies. When such occurrences do occur, it is the Board's desire to resolve them in a cooperative manner. It is the Air Resources Board's intent to minimize such occurrences.

ASSISTANCE

- The Air Resources Board recognizes the severe economic conditions now facing both state and local governments. Because of this, it is important that state and local resources be efficiently utilized to manage air quality in California. To this end, the Air Resources Board will, to the extent resources are available, continue to respond to districts' requests for technical assistance. The Air Resources Board will also continue to work with EPA, as necessary, to assist districts in fulfilling federal requirements.

FUNDING

- The Air Resources Board recognizes the need for adequate fiscal resources to carry out an effective air pollution control program at the local level. To this end, the Air Resources Board supports the adequate funding of local districts and will work with districts to provide for appropriate levels and sources of funding.

State of California
AIR RESOURCES BOARD

Resolution 83-3

April 20, 1983

Agenda Item No.: 83-4-3

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board (the "Board") to adopt standards, rules and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Sections 43013, 43101, and 43104 of the Health and Safety Code authorize the Board to adopt emissions standards and test procedures to control air pollution caused by motor vehicles, and pursuant to these provisions the Board has adopted emissions standards and test procedures for new motor vehicles;

WHEREAS, Section 43105 of the Health and Safety Code prohibits a manufacturer from selling, offering for sale, or delivering for sale, to the ultimate purchaser any new motor vehicle or vehicle engine when the manufacturer has violated emission standards or test procedures and has failed to take corrective action, which may include recall of vehicles or engines, and authorizes the Board to establish regulations specifying the procedures for determining, and facts constituting, compliance or noncompliance;

WHEREAS, Sections 43211 and 43212 of the Health and Safety Code provide for the recovery of civil penalties against manufacturers for the sale or offer for sale in California of any motor vehicle which does not comply with emission standards or test procedures;

WHEREAS, Section 43210(a) of the Health and Safety Code authorizes the Board to provide, by regulation, for the testing of motor vehicles on factory assembly lines or in a manner which the Board determines best suited to carry out the purposes of Part 5 of Division 26 of the Health and Safety Code;

WHEREAS, Section 43210(c) of the Health and Safety Code, added by Stats. 1981, ch. 1185 (AB 965), requires that the Board's assembly-line test procedures provide for reduced, statistically valid testing of motor vehicles contained in large engine families for which initial test results indicate compliance with the applicable standards;

WHEREAS, Title 13, California Administrative Code, Section 2061 presently establishes assembly-line test procedures for 1983 and subsequent model year vehicles;

WHEREAS, the assembly-line test procedures for 1983 and subsequent model years provide for quality audit testing, by manufacturers, of not less than two percent of California production of each engine family, except where "Excellence of Quality Control" provisions apply which permit quality audit testing of fewer than two percent of production in specified instances;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project having significant adverse environmental impact be adopted as originally proposed if feasible alternative or mitigation measures are available;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of the Administrative Procedure Act (Government Code, Title 2, Division 3, Part 1, Chapter 3.5); and

WHEREAS, the Board finds that:

The existing "Excellence of Quality Control" provisions are deficient in that they do not allow an engine family with emissions means substantially below the standards but with considerable variability to qualify for a reduced sampling rate; they do not permit a reduced sample rate until the second quarter of production; and they allow a full quarter between evaluation of test emission levels;

The amendments to the assembly-line test procedures for 1983 and subsequent model years approved herein are necessary to remedy these deficiencies;

The selection method contained in the amendments approved herein is statistically valid and provides for reduced testing;

The selection method provides for a more equitable test program for large production families;

The selection method provides for adequate demonstration of compliance with applicable standards; and

The amendments approved herein will have no significant adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves the amendments to Title 13, California Administrative Code, Section 2061, set forth in Attachment A hereto.

BE IT FURTHER RESOLVED that the Board hereby approves the amendments to the "California Assembly-Line Test Procedures for 1983 and Subsequent Model Year Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles", set forth in Attachment B hereto.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to adopt the amendments set forth in Attachments A and B after making them available to the public for a period of 15 days, provided, however, that the Executive Officer shall consider such written comments as may be submitted during this period, and shall present the regulations to the Board for further consideration if he determines that this is warranted in light of the written comments received.

BE IT FURTHER RESOLVED that the Board hereby determines that the regulations and procedures approved herein are in the aggregate at least as protective of public health and welfare as applicable federal standards and are consistent with Sections 202(a) and (b) of the Clean Air Act.

I hereby certify that this is a true and correct copy of Resolution 83-3, as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

ATTACHMENT A

Proposed Amendment to Title 13,
California Administrative Code, Section 2061

Amend Section 2061 to read as follows:

2061. Assembly-Line Test Procedures - 1983 and Subsequent Model Years.

New 1983 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles subject to certification and manufactured for sale in California shall be tested in accordance with the "California Assembly-Line Test Procedures for 1983 and Subsequent Model Year Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles," adopted November 24, 1981, as last amended _____, including federally certified light-duty motor vehicles, except as provided in "Guidelines for Certification of 1983 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California", adopted July 20, 1982.

NOTE: Authority cited: Sections 39515, 39601 and 43210, Health Safety Code. Reference: Sections 43102, 43105, 43210, 43211 and 43212, Health and Safety Code.

ATTACHMENT B

PROPOSED

State of California
AIR RESOURCES BOARD

California Assembly-Line Test Procedures for 1983 and Subsequent Model Year Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles

Adopted: November 24, 1981
Amended: _____

Note: These procedures are printed in a style to emphasize the differences from the 1983 and Subsequent Model Year Assembly-Line Test Procedures as adopted November 24, 1981. Additions are indicated by underlining and deletions are lined out with dashes.

On September 28, 1982, the Executive Officer conducted a public hearing to consider proposed amendments to these procedures, primarily concerning liquefied petroleum gas- and compressed or liquefied natural gas-powered vehicles. As these proposed amendments have not yet been adopted, they are not set forth in this document. The proposed amendments are set forth in a staff report issued for the September 28, 1982 hearing and available from the Public Information Office.

State of California
AIR RESOURCES BOARD

California Assembly-Line Test Procedures for 1983
and Subsequent Model Year Passenger Cars,
Light-Duty Trucks, and Medium-Duty Vehicles

A. GENERAL PROVISIONS

1. APPLICABILITY

These test procedures, adopted pursuant to Section 43210 of the California Health and Safety Code, are applicable to vehicle manufacturers of 1983 and subsequent model year gasoline and diesel-powered passenger cars, light-duty trucks, and medium-duty vehicles having an engine displacement of 50 cubic inches (820 cubic centimeters) or greater, except motorcycles, subject to registration and manufactured for sale in California.

2. COMPLIANCE

The procedures specify two types of tests: (1) a short inspection test to be applied to every vehicle before sale; and (2) a quality-audit test according to the "California Exhaust Emission Standards and Test Procedures for 1981 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles". A vehicle is in compliance with these assembly-line standards and test procedures when that vehicle is in compliance with the inspection test requirements and that vehicle's engine family is in compliance with the quality-audit test requirements. Since quality-audit evaluations occur less frequently than the inspection tests, a vehicle which passes the inspection test may be presumed to be in compliance with the full assembly-line procedures pending meeting the quality-audit evaluation of that vehicle's engine family.

3. DECAL

H & SC Section 43200 requires manufacturers to affix a window decal in accordance with specific requirements. No vehicle subject to these test procedures may be sold and registered in this state which is not in compliance with the requirements of Section 43200 and this paragraph.

Each vehicle emission decal shall have the applicable exhaust emission standards and the following statement displayed thereon with the appropriate model year:

"This vehicle has been tested under and conforms to California Assembly-Line Test Requirements for the (Calendar Model Year) Model Year."

4. ACCESS

Air Resources Board personnel and mobile laboratories shall have access to vehicle assembly plants, distribution facilities, and test facilities for the purpose of vehicle selection, testing, and observation. Scheduling of access shall be arranged with the designated manufacturer's representative and shall not unreasonably disturb normal operations.

5. VARIATIONS AND EXEMPTIONS

Variations from these procedures which produce substantially equivalent results may be authorized by the Executive Officer. In extraordinary circumstances where compliance with these procedures is not possible or practicable, a manufacturer may appeal to the Air Resources Board for a temporary exemption.

6. COMMUNICATIONS

All reports required by these procedures shall be sent to:

Chief, Mobile Source Control Division
California Air Resources Board
9528 Telstar Avenue
El Monte, CA 91731

B. INSPECTION TEST PROCEDURES

This inspection test shall be performed on all vehicles subject to these test procedures.

1. INSPECTION TEST PROCEDURES

(a) Functional Test

Functional tests of the engine components and control systems which affect emissions shall be made prior to the steady-state emissions tests. If a vehicle fails one or more functional tests, it must be repaired and pass a functional retest before it can be emissions tested.

A list of the items to be functionally checked and a procedure for performing these checks shall be maintained by the manufacturer and may be requested for review at anytime after production start-up by the Chief, Mobile Source Control Division. When requested, the manufacturer has up to 30 days to submit a copy of these procedures. Within 60 days of receipt the Chief, Mobile Source Control Division may require revisions.

(b) Steady-State Emissions Test

The vehicle engine shall be adjusted to the manufacturer's specifications for delivery to the customer prior to the steady-state emissions test. This test shall consist of a determination of hydrocarbon

4. ACCESS

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A list of the items to be functionally checked and a procedure for performing these checks shall be maintained by the manufacturer and may be requested for review at anytime after production start-up by the Chief, Mobile Source Control Division. When requested, the manufacturer has up to 30 days to submit a copy of these procedures. Within 60 days of receipt the Chief, Mobile Source Control Division may require revisions.

(b) Steady-State Emissions Test

The vehicle engine shall be adjusted to the manufacturer's specifications for delivery to the customer prior to the steady-state emissions test. This test shall consist of a determination of hydrocarbon

(HC) and carbon monoxide (CO) exhaust concentrations with the engine operating in a normal idle condition. All tests, including those of control limit test vehicles, shall be conducted as follows:

(1) Vehicles shall be tested in the normal "warmed-up" operating temperature range, i.e., after the choke is fully open and the engine is at curb idle speed, but before thermal override devices are actuated to prevent overheating. The test may be performed in any transmission gear; however the same gear shall be used for control limit test vehicles and production vehicles. For each engine family, the idle test may be performed without the air injection system (AIR) instead of with AIR, provided that the control limit vehicles are tested both with and without AIR. The requirements of Section B (3)(g) must be met with AIR.

The control limit test vehicles and all production vehicles should be warmed-up and tested in the same manner.

(2) The sampling probes of the analytical system shall be inserted into the exhaust outlets far enough to avoid dilution with the outside air. Where this is not possible, a tailpipe extension shall be used.

(3) A vehicle which fails a steady-state emissions test shall be retested or repaired and shall pass on retest prior to sale.

2. EVALUATION

Any vehicle tested by the steady-state emissions test showing emissions less than the control limits established for its engine family or subgroup and which had previously passed the functional tests will be considered to be in compliance with the inspection test requirements.

3. CONTROL LIMITS

The control limits for each engine family or subgroup at the start of a model year will be determined as follows:

(a) Measure the emissions from the first 100 vehicles of each engine family or subgroup tested by the steady-state assembly-line inspection test.

(b) Determine the mean emission level and standard deviation for each pollutant (HC and CO).

(c) The control limit for each pollutant is the sum of the mean plus two times the standard deviation for that pollutant.

(d) Until the first control limits are established, the manufacturer shall use temporary control limits based on the first ten tests. These ten vehicles are deemed to meet the control limits so established.

(e) (i) For control systems that do not use catalytic converters -- If the HC control limit value is determined in subparagraph (c) is less than 100 ppm, the HC control limit value may be increased by up to 50 ppm, not to exceed 100 ppm. If the CO control limit determined in subparagraph (c) is less than 1.0 percent, the CO control limit may be increased by up to 0.5 percent, not to exceed 1.0 percent.

(ii) For control systems that use catalytic converters -- If the HC control limit value determined in subparagraph (c) is less than 50 ppm, the control limit value may be increased by up to 30 ppm, not to exceed 50 ppm.

If the CO control limit determined in subparagraph (c) is less than 0.5 percent, the CO control limit may be increased by up to 0.3 percent, not to exceed 0.5 percent.

(f) Idle control limit values may be rounded to the nearest 10 ppm HC and 0.1 percent CO in conformance to ASTM E29-67, except where this would result in a zero value.

(g) The maximum allowable steady-state control limits for HC and CO are those values used as the idle mode standard shown in Title 13, California Administrative Code (C.A.C.) Section 2176 for the applicable model year or, where applicable model year standards are not yet adopted, the latest previous model year values in effect at the time the vehicle is manufactured. An exemption to this requirement will be granted providing the manufacturer submits emission data with each quarterly report listed in one of the following options:

(1) Submit with each quarterly assembly-line report HC and CO emission values measured at engine idle speed for each quality audit vehicle tested and the computed mean and standard deviation of HC and CO emission results for the total number of vehicles tested, by engine family. Measurements of HC and CO shall be conducted immediately following completion of the dynamometer run and vehicles shall be in a state described under B.1 (b)(1) above. If less than 30 vehicles were quality-audit tested during the reporting quarter, the computation of the means and standard deviations are not required.

(2) Submit quarterly HC and CO emission values measured at engine idle speed for a minimum of 30 vehicles in the engine family or sub-group immediately after these vehicles have complied with the assembly-line inspection procedures and have either been run-in a distance of 50 miles (on the road or dynamometer) or after other appropriate engine break-in has been performed and the engine is operating at a fully warmed-up condition as described in B.1 (b)(1) above. In addition to emission results of individual vehicles, the mean and standard deviation shall be computed and submitted.

(3) The manufacturer may propose other methods to achieve results equivalent to the two operations above. These emission data shall be obtained from stabilized vehicles which have emission control systems with no defects and are properly adjusted to manufacturer's specifications.

(e) (i) For control systems that do not use catalytic converters -- If the HC control limit value is determined in subparagraph (c) is less than 100 ppm, the HC control limit value may be increased by up to 50 ppm, not to exceed 100 ppm. If the CO control limit determined in subparagraph (c) is less than 1.0 percent, the CO control limit may be increased by up to 0.5 percent, not to exceed 1.0 percent.

(ii) For control systems that use catalytic converters -- If the HC control limit value determined in subparagraph (c) is less than 50 ppm, the control limit value may be increased by up to 30 ppm, not to exceed 50 ppm.

If the CO control limit determined in subparagraph (c) is less than 0.5 percent, the CO control limit may be increased by up to 0.3 percent, not to exceed 0.5 percent.

(f) Idle control limit values may be rounded to the nearest 10 ppm HC and 0.1 percent CO in conformance to ASTM E29-67, except where this would result in a zero value.

(g) The maximum allowable steady-state control limits for HC and CO are those values used as the idle mode standard shown in Title 13, California Administrative Code (C.A.C.) Section 2176 for the applicable model year or, where applicable model year standards are not yet adopted, the latest previous model year values in effect at the time the vehicle is manufactured. An exemption to this requirement will be granted providing the manufacturer submits emission data with each quarterly report listed in one of the following options:

(1) Submit with each quarterly assembly-line report HC and CO emission values measured at engine idle speed for each quality audit vehicle tested and the computed mean and standard deviation of HC and CO emission results for the total number of vehicles tested, by engine family. Measurements of HC and CO shall be conducted immediately following completion of the dynamometer run and vehicles shall be in a state described under B.1 (b)(1) above. If less than 30 vehicles were quality-audit tested during the reporting quarter, the computation of the means and standard deviations are not required.

(2) Submit quarterly HC and CO emission values measured at engine idle speed for a minimum of 30 vehicles in the engine family or sub-group immediately after these vehicles have complied with the assembly-line inspection procedures and have either been run-in a distance of 50 miles (on the road or dynamometer) or after other appropriate engine break-in has been performed and the engine is operating at a fully warmed-up condition as described in B.1 (b)(1) above. In addition to emission results of individual vehicles, the mean and standard deviation shall be computed and submitted.

(3) The manufacturer may propose other methods to achieve results equivalent to the two operations above. These emission data shall be obtained from stabilized vehicles which have emission control systems with no defects and are properly adjusted to manufacturer's specifications.

(h) Control limits with AIR operating shall be calculated and reported for information purposes for those engine families that are tested without AIR in operation.

Control limit values shall be recalculated for each production quarter based on the measured emissions from at least 100 vehicles produced during the last half of the preceding quarter of production for each engine family or subgroup tested by the steady-state emissions test. When production levels do not permit compliance with the above, data from vehicles produced during the first half of the preceding quarter may be used. If the quarterly production of any engine family is less than 100 vehicles, the manufacturer shall use the test results from all vehicles produced during that quarter in determining the control limit values for the next quarter.

The Executive Officer shall be notified within one week if control limit values are recalculated following running changes which affect idle emissions levels. The new control limit values and the date they first went into effect shall be part of the notification.

All testing, reports, evaluations, etc., shall be by engine family except when the Executive Officer has approved a breakdown by subgroups (e.g., different carburetors, engine displacements, control systems, transmissions, and inertia weights), by assembly plant, or both.

Note:

Data from any vehicle indicating gross engine malfunction, and/or failure or disconnection of any emission control component, shall be excluded from that used for generating control limits. Retest data on vehicles exceeding the control limits shall not be used in determining control limits for subsequent quarters.

4. REPORTS

Reports shall be submitted to the Air Resources Board within 45 calendar days of the end of each calendar quarter and within 45 calendar days of the end of the manufacturer's model production year. Results for two different model years shall not be combined statistically.

The report shall include:

(a) The temporary quarterly control limit values obtained for the first quarter of production.

(b) The mean and the standard deviation of the steady-state emissions tests used to determine the quarterly control limits.

(c) The steady-state control limit values for the next quarter's production.

(d) From a representative sample of vehicles approved by the Executive Officer, the number and percentage of vehicles:

(1) failing the first test

(2) repaired or adjusted.

All HC values should be stated as hexane equivalents for NDIR measurement and ppm carbon if a flame ionization detector is used. The hexane equivalent conversion value shall be supplied for each different model of flame ionization detector used and for each engine family.

C. QUALITY-AUDIT TEST PROCEDURES

1. VEHICLE SAMPLE SELECTION

The vehicle manufacturer shall randomly select vehicles ~~with~~ from each engine family for quality-audit testing. Each selected vehicle for quality-audit testing must pass the inspection test, be equipped with emission control systems certified by the ARB, and be representative of the manufacturer's California sales. The procedure for randomly selecting vehicles must be submitted to the Chief, Mobile Source Control Division, El Monte, CA prior to production.

A continuous sample rate shall be chosen by the manufacturer to provide a sample which is representative of the total production. The manufacturer shall select a sample rate which he or she determines will be satisfactory for use by the Air Resources Board in determining the number of vehicles in the entire population of a particular engine family which do not meet Board-established emission standards by extrapolation from the percentage of the sample not meeting the standards. The results from the sample may be extrapolated to the entire population subject to the provisions relating to vehicle exclusion contained in paragraph 3 which follows. The sample rate so chosen shall not be less than 2.0 percent. The manufacturer shall notify the Executive Officer of any change to the sample rate. The date of such change shall be reported in accordance with paragraph ~~7~~ 6 which follows.

A vehicle manufacturer may use, as an alternate to the above vehicle selection procedure, the optional procedure outlined in Appendix A.

Four-wheel drive vehicles which can be manually shifted to a two-wheel drive mode will be tested in the normal on-highway two-wheel drive mode of operation. If full-time four-wheel drive vehicles are selected, substitutions may be made with comparable two-wheel drive vehicles of the same engine family. If comparable two-wheel drive vehicles are not available, selected full-time four-wheel drive vehicles will be tested after having the front drive wheels temporarily disengaged or the front end of the vehicle elevated.

The Executive Officer may, upon notice to the manufacturer, require the sample rate to be increased to a maximum of ten percent of production (not to exceed 30 additional vehicles) of the calendar quarterly production of any engine family by invoking Section 2110, Chapter 3, Title 13 of the C.A.C.

(d) From a representative sample of vehicles approved by the Executive Officer, the number and percentage of vehicles:

(1) failing the first test

(2) repaired or adjusted.

All HC values should be stated as hexane equivalents for NDIR measurement and ppm carbon if a flame ionization detector is used. The hexane equivalent conversion value shall be supplied for each different model of flame ionization detector used and for each engine family.

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2. VEHICLE PREPARATION AND PRECONDITIONING

(a) After the inspection tests, no emissions tests may be performed on a quality-audit vehicle prior to the first quality-audit test, except where such tests are run on all vehicles manufactured for sale in California.

(b) The vehicle shall begin the test sequence as received from the inspection test, except for mileage accumulation or engine run-in. The schedule for mileage accumulation or engine run-in and any changes to the schedule must be submitted to the Executive Officer with each quarterly report. This schedule must be adhered to for all quality-audit testing within an engine family and subgroup or engine family and assembly plant as appropriate.

(c) A new carbon canister may be installed on the vehicle at the start of the test sequence. The test sequence shall consist of one Urban Dynamometer Driving Schedule (UDDS) test procedure, followed by a cold-soak and constant volume sample (CVS) test. The federal test procedure requirement, consisting of heating the fuel before the CVS test, is to be omitted. The manufacturer may request permission to use an alternate preconditioning procedure provided the manufacturer demonstrates that it will not affect the loading of the carbon canister when compared with the UDDS.

(d) Except as provided in paragraph C.2.(f) below, no vehicle selected for quality-audit testing shall be repaired or adjusted after passing the inspection test, except for a vehicle that: (1) is not testable, e.g., cannot be started, transmission or brakes lock-up; (2) is not reasonably operative, e.g., some transmission gears not functioning; (3) is unsafe to test; or (4) would be damaged by testing.

Each adjustment or repair performed on a vehicle prior to each test shall be included in the regular quarterly reports. The vehicle condition and symptoms and reason(s) for each repair or adjustment shall also be listed.

(e) If a vehicle is shipped to a remote facility for quality-audit testing, correction of damage or maladjustment, which is found to have resulted from shipment of the vehicle, is permitted only after the initial test of the vehicle, except as provided in paragraph (d) above.

All adjustments or repairs performed on vehicles prior to each test shall be reported to the Executive Officer by inclusion in the quarterly report. The vehicle condition and symptoms and reason(s) for each repair or adjustment shall also be listed. In the event a retest is performed, application may be made to the Executive Officer for permission to substitute the after-repair test results for the original test results. The Executive Officer will either affirm or deny the application. When requested by the manufacturer, no more than ten days after the production quarter, response from the Executive Officer will be within ten working days.

(f) If a vehicle is shipped to a remote facility for quality-audit testing, no pre-delivery type inspection, adjustment, or repair of vehicles selected for quality-audit is allowed, except as follows: if subsequent to shipping from the assembly-line, the manufacturer performs the particular inspection and correction of damage or maladjustment at designated preparation facility locations for all vehicles produced and the manufacturer's written inspection instructions are approved by the Executive Officer, then these specific inspections and corrections will be allowed prior to testing quality-audit vehicles.

(g) If the emission test results of a vehicle are determined to be invalid by the manufacturer, the vehicle must be retested. Emission results from all tests shall be reported. A detailed report on the reasons for each invalidated test shall be included in the quarterly report.

3. STANDARDS AND TEST PROCEDURES

The emission standards and the exhaust sampling and analytical procedures shall be those described in the "California Exhaust Emission Standards and Test Procedures for 1981 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles" applicable to vehicles tested for exhaust emissions only, with exceptions or additions as shown in paragraph C.2.

4. EVALUATION

The evaluation shall be performed on sample sizes containing 30 or more vehicles. If a sample size for a particular production quarter is less than 30 vehicles, the data from that quarter shall be combined with the data from each successive quarter until at least 30 vehicles have been quality-audit tested. If the sample size for the last quarter's production does not contain at least 30 vehicles, the data from the last quarter shall be combined with each preceding quarter until the sample size contains at least 30 vehicles. For an engine family which contains both light-duty trucks and medium-duty vehicles, all references in this test procedure to engine family shall mean light-duty truck subgroup or medium-duty vehicle subgroup.

Based upon additional information submitted by a manufacturer, the Executive Officer may allow rejection of any data from vehicles if they are considered to be not representative of production.

For each production quarter, if 30 or more vehicles are tested, the ARB shall consider that probable cause exists for finding a violation by any engine family if the average emissions of any pollutant, after multiplying the emission data of each vehicle by the appropriate certification deterioration factor (DF), exceed the applicable year exhaust emission standards, when rounded to the same number of significant digits as the standard.

The Executive Officer may invoke Section 2109, Chapter 3, Title 13 of the C.A.C. if probable cause is found for a full or combined production quarter. The Executive Officer may invoke Section 2110, Chapter 3, Title 13 of the C.A.C., if probable cause is found for a short start-up production

(f) If a vehicle is shipped to a remote facility for quality-audit testing, no pre-delivery type inspection, adjustment, or repair of vehicles selected for quality-audit is allowed, except as follows: if subsequent to shipping from the assembly-line, the manufacturer performs the particular inspection and correction of damage or maladjustment at designated preparation facility locations for all vehicles produced and the manufacturer's written inspection instructions are approved by the Executive Officer, then these specific inspections and corrections will be allowed prior to testing quality-audit vehicles.

(g) If the emission test results of a vehicle are determined to be invalid by the manufacturer, the vehicle must be retested. Emission results from all tests shall be reported. A detailed report on the reasons for each invalidated test shall be included in the quarterly report.

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Based upon additional information submitted by a manufacturer, the Executive Officer may allow rejection of any data from vehicles if they are considered to be not representative of production.

For each production quarter, if 30 or more vehicles are tested, the ARB shall consider that probable cause exists for finding a violation by any engine family if the average emissions of any pollutant, after multiplying the emission data of each vehicle by the appropriate certification deterioration factor (DF), exceed the applicable year exhaust emission standards, when rounded to the same number of significant digits as the standard.

The Executive Officer may invoke Section 2109, Chapter 3, Title 13 of the C.A.C. if probable cause is found for a full or combined production quarter. The Executive Officer may invoke Section 2110, Chapter 3, Title 13 of the C.A.C., if probable cause is found for a short start-up production

period (less than a full calendar quarter), for the first thirty vehicles quality-audit tested during any production quarter or from the start of production, or for vehicles evaluated in accordance with the monthly evaluation required by paragraph 4 below. In addition, the ARB may seek statutory penalties pursuant to H & SC Sections 43211 and 43212 at the end of each full or combined calendar quarter of production. If the Executive Officer invokes C.A.C. Section 2109 or 2110, an evaluation will be made on vehicles produced subsequent to the invocation of a plan adopted pursuant to Section 2109 or 2110 as long as the sample size contains at least 30 vehicles.

If more than 1.0 percent (at least two vehicles) of the sample within an engine family has projected emissions which exceed the applicable standards by more than 2.33 standard deviations at the time of any evaluation of that family's average emissions within 30 working days, the manufacturer shall submit: (a) an analysis of the projected average emissions for each engine code/transmission type/inertia weight combination within that family; (b) an engineering evaluation of the cause of failure for each vehicle which exceeded the standard by more than 2.33 standard deviations; (c) the manufacturer's opinion as to the nature of the problem; and (d) any corrective action proposed by the manufacturer.

The Executive Officer shall review the report, and may require that the proposed corrective action be taken. If, after review of the report, the Executive Officer finds the proposed corrective action inadequate, the Executive Officer may invoke Section 2109 or 2110, as appropriate.

~~5. TEST-SAMPLE-SIZE-CRITERIA-AND-BENEFIT-FOR-ACHIEVING-EXCELLENCE-OF QUALITY-CONTROL~~

~~Benefits-will-be-provided-as-incentives-for-reducing-the-number-of vehicles-built-which,-if-repaired,-would-provide-significantly-reduced emissions.--Evaluations-are-to-be-made-by-the-vehicle-manufacturer-on-a quarterly-basis.~~

~~A-statistical-calculation-procedure-for-determining-an-allowable acceptance-number-(c)-will-be-used.--This-method-is-provided-in-the-Appendix. The-calculation-shall-be-applied-to-the-emission-test-results-for-HC,-CO,-and oxides-of-nitrogen-(NOx)-of-quality-audit-vehicles-for-each-production quarter.--When-the-calculation-shows-that-an-engine-family-meets-the-criteria for-excellence-of-quality-control-described-in-the-Appendix,-then-the-vehicle manufacturer-may-change-the-sample-rate-to-less-than-two-percent-(2%) following-the-sample-size-calculation-provided.~~

~~SUSPENSION-OF-BENEFIT~~

~~If-in-a-subsequent-quarter-an-engine-family-does-not-meet-the-criteria for-excellence-of-quality-control,-then-the-originally-selected-two-percent (2%)-minimum-sample-rate-shall-resume-for-the-following-production-quarter's quality-audit-vehicles.~~

~~REINSTATEMENT OF BENEFIT~~

~~The manufacturer may change the sample rate to less than a two percent (2%) minimum during the following production quarter, when the above criteria for excellence of quality control is met again.~~

~~INCREASED TESTING FOR POOR QUALITY~~

~~When the above statistical calculation procedure shows that the acceptance number of, exceeds fifteen (15) percent or more of the vehicles tested, and in addition at least fifteen (15) percent of the vehicles tested individually exceed an emission standard, the manufacturer shall notify in writing within ten working days of the quarter's end, the Chief of Mobile Source Control Division, who may increase the quality audit sample size up to a maximum of ten percent of production, but not to exceed 30 additional vehicles per calendar quarter.~~

~~6.~~ 5. NON-METHANE (NMHC) OR TOTAL HYDROCARBON (THC) MEASUREMENTS

(a) For an engine family certified to the NMHC standard, the manufacturer shall measure the NMHC content which shall be multiplied by the non-methane DF.

(b) For an engine family certified to the THC standard, the measured THC value shall be multiplied by the THC DF.

~~7.~~ 6. REPORTS

Each vehicle manufacturer shall submit a report to the Air Resources Board within 45 calendar days after the end of each calendar quarter and 45 calendar days after the end of the production year. More frequent reports may be required if the Executive Officer invokes C.A.C. Section 2109 or 2110, Chapter 3, Title 13. Each vehicle manufacturer shall review the test results of the first 30 test vehicles of each engine family for each calendar quarter of production or from the start of production, and the quarter's cumulative test results of each engine family at the end of each month. If the sample size is 30 or more vehicles, the Chief, Mobile Source Control Division, shall be notified in writing within 10 working days whenever an engine family exceeds an emission standard.

The quarterly report shall include the following:

(a) The total production and sample size for each engine family.

(b) A description of each test vehicle ((i.e., date of test, engine family, engine size, vehicle identification number, fuel system (e.g., number of venturi, fuel injection, etc.), transmission type, test weight used, dynamometer power absorber setting in horsepower, engine code or calibration number and test location)).

(c) The CVS exhaust emission data and carbon dioxide data for each test vehicle.

~~REINSTATEMENT-OF-BENEFIT~~

~~The-manufacturer-may-change-the-sample-rate-to-less-than-a-two-percent-(2%)-minimum-during-the-following-production-quarter,-when-the-above-criteria-for-excellence-of-quality-control-is-met-again.~~

~~INCREASED-TESTING-FOR-POOR-QUALITY~~

~~When-the-above-statistical-calculation-procedure-shows-that-the-acceptance-number-is,-exceeds-fifteen-(15)-percent-or-more-of-the-vehicles--tested,-and-in-addition-at-least-fifteen-(15)-percent-of-the-vehicles-----tested-individually-exceed-an-emission-standard,-the-manufacturer-shall notify-in-writing-within-ten-working-days-of-the-quarter's-end,-the-Chief-of-Mobile-Source-Control-Division,-who-may-increase-the-quality-audit-sample-size-up-to-a-maximum-of-ten-percent-of-production,-but-not-to-exceed-30-additional-vehicles-per-calendar-quarter.~~

~~6.~~ 5. NON-METHANE (NMHC) OR TOTAL HYDROCARBON (THC) MEASUREMENTS

(a) For an engine family certified to the NMHC standard, the manufacturer shall measure the NMHC content which shall be multiplied by the non-methane DF.

(b) For an engine family certified to the THC standard, the measured THC value shall be multiplied by the THC DF.

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Each vehicle manufacturer shall submit a report to the Air Resources Board within 45 calendar days after the end of each calendar quarter and 45 calendar days after the end of the production year. More frequent reports may be required if the Executive Officer invokes C.A.C. Section 2109 or 2110, Chapter 3, Title 13. Each vehicle manufacturer shall review the test results of the first 30 test vehicles of each engine family for each calendar quarter of production or from the start of production, and the quarter's cumulative test results of each engine family at the end of each month. If the sample size is 30 or more vehicles, the Chief, Mobile Source Control Division, shall be notified in writing within 10 working days whenever an engine family exceeds an emission standard.

The quarterly report shall include the following:

(a) The total production and sample size for each engine family.

(b) A description of each test vehicle ((i.e., date of test, engine family, engine size, vehicle identification number, fuel system (e.g., number of venturi, fuel injection, etc.), transmission type, test weight used, dynamometer power absorber setting in horsepower, engine code or calibration number and test location)).

(c) The CVS exhaust emission data and carbon dioxide data for each test vehicle.

The data reported shall be rounded to one significant figure beyond the number of significant figures in the applicable standard. DF's shall be stated, then applied to the data. The data reported after the DF's are applied shall be rounded using the "rounding off method" specified in ASTM: E29-67 to the number of places to the right of the decimal point as follows for all vehicles:

HC	CO	NOx	CO_2
.XXX	.XX	.XX	.X

(d) The retest emissions data as described in paragraph (c) above for any vehicles failing the initial test, and description of the corrective measures taken, including specific components replaced or adjusted.

(e) A statistical analysis of the quality-audit test results for each engine family stating:

(1) Number of vehicles tested.

(2) Average emissions and standard deviations of the sample for HC, CO and NOx both before and after applying DF's. In the latter case, the individual test points shall be multiplied by the DFs prior to computing the average and standard deviation. The average emissions and standard deviation of the sample for carbon dioxide shall also be listed.

(3) The applicable exhaust emission standards to be met, listing specific options selected, and designating when 100,000 mile standards apply, and where NMHC or THC standards apply.

(f) Every aborted test and reason for abort shall be reported.

(g) If both four-wheel and two-wheel drive vehicles are included in a light-duty truck engine family under 4,000 pounds inertia weight, then quality-audit test data from four-wheel drive vehicles shall be distinguished from and summarized separately from two-wheel drive vehicles.

(h) Control limits with AIR operating shall be calculated and reported for information purposes for those engine families that are tested without AIR in operation.

(i) The final report shall include the date of the end of the manufacturer's model production year for each engine family.

8. 7. SPECIAL REQUIREMENTS FOR SMALL VOLUME VEHICLE MANUFACTURERS

The following requirements apply only to those vehicle manufacturers who were granted relief, by the Executive Officer, under Title 13, C.A.C., Section 1960.4, Special Standards for 1982 and Subsequent Model Passenger Cars and 1983 and Subsequent Model Light-Duty Trucks and Medium-Duty Vehicles, 0-3999 Pound Equivalent Inertia Weight.

The requirements listed below are to be followed as supplemental to and when contrary to other requirements specified in part "C. Quality-Audit Test Procedures", Section "3. Evaluation", and "4. Reports". These requirements are listed to implement, define, and clarify the Board requirements of C.A.C. Section 1960.4.

a. Additional Reporting Requirements for NOx Emissions

(1) The cumulative average of NOx emissions from the entire quality-audit light-duty trucks (LDT) plus medium-duty vehicles (MDV) 0-3999 lbs. equivalent inertia weight, shall be reported both before and after applying DF's for the 1983 model year to:

(i) All 1983 models tested during each calendar quarter.

(ii) All 1983 models tested to date by the end of each calendar quarter.

(iii) All 1983 models tested to date by December 31, 1982, by June 30, 1983, and by December 31, 1983.

(2) The combined averages from the entire passenger car (PC) line and, separately, LDT and MDV lines, 0-3999 lbs. equivalent inertia weight, shall be reported both before and after applying DF's for:

(i) All 1983 model PC's tested during each calendar quarter.

(ii) All 1984 model PC's and, separately, LDT's plus MDV's tested during each calendar quarter.

(iii) All 1985 model LDT's plus MDV's tested during each calendar quarter.

(3) Subgroups

The NOx emission results shall be averaged and reported by engine family subgroup in each regular quarterly assembly-line report.

b. Semi-Annual Evaluations

Joint ARB - manufacturer evaluations will be made each six months to determine compliance with the 0.7 gm/mi NOx production level based on test results by engine families separately for 1983 and 1984 model PC's and 1984 and 1985 model LDT's plus MDV's tested and on a cumulative basis for 1983 model LDT's plus MDV's. The first evaluation will be made based on averaged NOx test data accumulated through December 31, 1982. Subsequent evaluations will be made semiannually for data accumulated through each June 30 and December 31 periods until December 31, 1984, for PC's and December 31, 1985, for LDT's plus MDV's model year productions.

The requirements listed below are to be followed as supplemental to and when contrary to other requirements specified in part "C. Quality-Audit Test Procedures", Section "3. Evaluation", and "4. Reports". These requirements are listed to implement, define, and clarify the Board requirements of C.A.C. Section 1960.4.

a. Additional Reporting Requirements for NOx Emissions

(1) The cumulative average of NOx emissions from the entire quality-audit light-duty trucks (LDT) plus medium-duty vehicles (MDV) 0-3999 lbs. equivalent inertia weight, shall be reported both before and after applying DF's for the 1983 model year to:

(i) All 1983 models tested during each calendar quarter.

(ii) All 1983 models tested to date by the end of each calendar quarter.

(iii) All 1983 models tested to date by December 31, 1982, by June 30, 1983, and by December 31, 1983.

(2) The combined averages from the entire passenger car (PC) line and, separately, LDT and MDV lines, 0-3999 lbs. equivalent inertia weight, shall be reported both before and after applying DF's for:

(i) All 1983 model PC's tested during each calendar quarter.

(ii) All 1984 model PC's and, separately, LDT's plus MDV's tested during each calendar quarter.

(iii) All 1985 model LDT's plus MDV's tested during each calendar quarter.

(3) Subgroups

The NOx emission results shall be averaged and reported by engine family subgroup in each regular quarterly assembly-line report.

b. Semi-Annual Evaluations

Joint ARB - manufacturer evaluations will be made each six months to determine compliance with the 0.7 gm/mi NOx production level based on test results by engine families separately for 1983 and 1984 model PC's and 1984 and 1985 model LDT's plus MDV's tested and on a cumulative basis for 1983 model LDT's plus MDV's. The first evaluation will be made based on averaged NOx test data accumulated through December 31, 1982. Subsequent evaluations will be made semiannually for data accumulated through each June 30 and December 31 periods until December 31, 1984, for PC's and December 31, 1985, for LDT's plus MDV's model year productions.

If the NOx value exceeds the 0.7 gm/mi level, but the manufacturer shows that unanticipated technical problems caused the 0.7 gm/mi NOx production average to be exceeded, then appropriate relief will be made available. The relief will be made provided the manufacturer shows reasonable effort was made and will continue to be made towards meeting the 0.7 gm/mi NOx levels for future production periods. This includes incorporating into production improved technology as soon as it becomes available.

After the evaluation, the Executive Officer can invoke Section 2109, Title 13 of the C.A.C. if combined test results exceed the 0.7 gm/mi NOx level separately for 1983 and 1984 model PC's and 1984 and 1985 model LDT's plus MDV's, and on a cumulative basis for 1983 model LDT's plus MDV's provided that the manufacturer has not taken appropriate corrective action.

~~The reports required by this paragraph and paragraph B.4. should be sent to:~~

~~Chief, Mobile Source Control Division~~
~~California Air Resources Board~~
~~9528 Telstar Avenue~~
~~El Monte, CA 91731~~

DEFINITIONS

The definitions in Section 1900 (b), Chapter 3, Title 13 of the California Administrative Code, shall apply with the following additions:

1. Calendar Quarter is defined as those three month periods of time which start on the first days of January, April, July and October.

2. First or Last Calendar Quarter Production is defined as the calendar quarter in which the production of an engine family begins or ends.

3. End of Assembly-Line is defined as that place where the final inspection test or quality-audit test is performed.

4. Assembly-Line Tests are those tests or inspections which are performed at the end of the assembly-line.

5. Assembly-Line Quality Audit-Test is defined as the test performed on a minimum sample of 2.0 percent of the production vehicles for sale in California.

6. Assembly-Line Inspection Tests are those steady-state and functional tests performed on production vehicles for sale in California.

7. Functional Test is defined as a type of test or inspection which is performed on engines or vehicles to detect if the emission control system is operating properly.

8. Gross Engine Malfunction is defined as one yielding an emission value greater than the sum of the mean plus three (3) times the standard deviation. This definition shall apply only for determination of control limits.

APPENDIX

Evaluating Vehicle Emissions Assembly Line Quality Control from Quality Audit Data

I. Procedure for Determining Excellence of Quality Control

A. Calculation of Acceptance Number, Individually for HC, CO, and NOx

1. Calculate the mean and standard deviation of the entire quality audit data set:

$$\text{Mean} = \bar{x} = (\Sigma x_i)/N$$

$$\text{Standard deviation} = S = \left(\frac{\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{N}}{N-1} \right)^{1/2}$$

where x_i = Individual emission values.

N = Total number of data points.

2. Calculate Cut Point

Provisional cut point = $\bar{x}$ + 3 Std. Deviations

3. Identify and remove all data values greater than the provisional cut point and repeat steps 1 and 2.

4. Continue with steps 1, 2, and 3 until no values are found above the final cut point.

5. The acceptance number (c) is the total number of data values above the final cut point.

B. Determination of Excellence of Quality Control from Acceptance Number

Excellence of quality control may exist if the acceptance number calculated in paragraph I.A. is equal to or less than the value given in the table below for the corresponding quality audit sample size.

Quality Audit Sample Size	Allowable Acceptance Number (c)
50-59	1
60-99	2
100-139	3
140-209	4
210-270	5

If the quality audit sample size is greater than 270, the evaluation will be made on the first 270 quality audit vehicles tested.

C. Determination of Quality Audit Sample Size for the Next Quarter when the acceptance number criteria in paragraph I.B. are met.

1. Calculate Tchebysheff's K for each contaminant:

$$K_i = \frac{\left(\text{Standard}_i - \bar{x}_i \right)}{\sqrt{\frac{S_i^2}{n} \cdot \frac{(N-n)}{N}}}$$

where i = contaminant, HC, CO, NOx
standard = emission standard for particular contaminant

$\bar{x}_i$ = mean of particular contaminant for current quarter

B. Determination of Excellence of Quality Control from Acceptance Number

Excellence of quality control may exist if the acceptance number calculated in paragraph I.A. is equal to or less than the value given in the table below for the corresponding quality audit sample

Quality Audit Sample Size	Allowable Acceptance Number (c)
50-59	1
60-99	2
100-139	3
140-209	4
210-270	5

If the quality audit sample size is greater than 270, the evaluation will be made on the first 270 quality audit vehicles tested.

C. Determination of Quality Audit Sample Size for the Next Quarter when the acceptance number criteria in paragraph I.B. are met.

1. Calculate Tchebysheff's K for each contaminant:

$$K_i = \frac{\left(\text{Standard}_i - \bar{x}_i \right)}{\sqrt{\frac{S_i^2}{n} \cdot \frac{(N-n)}{N}}}$$

where i = contaminant, HC, CO, NOx
standard = emission standard for particular contaminant

$\bar{x}_i$ = mean of particular contaminant for current quarter

S_i^2 = variance of particular contaminant for current quarter
N = Total number of vehicles produced for the current quarter.
n = Quality Audit sample size for the current quarter

a. If all K_i = 2, the sample size for the next quarter = 50.

b. If any K_i = 2, the sample size for the next quarter will be 2% (minimum)

NOTE: For manufacturers whose production is less than 2500, the sample size of 2% (or less than 50) shall apply.

II. General Procedure Explanation

The overall procedure for determining the next quarter's quality audit sampling rate is presented in a flow diagram in Figure 1. The flow sheet is for a period of one model year.

The sampling rate is a 2% minimum of production for all manufacturers for the first quarter. The sampling rate may be reduced for the following quarters when the criteria for excellence of quality control is met the previous quarter using the calculations of Section I. The acceptance number c' is calculated for the current quarter as per Section I.A. The table in Section I.B. is entered to find the allowable acceptance number c for the sample size of the current quarter. If the acceptance number c' is equal to or less than the allowable acceptance number c for HC, CO and NOx, then that engine family may meet the criteria for excellence of quality control. If the engine family does not meet these criteria, the sample size for the next quarter for that engine family shall be 2% of the next quarter's production.

If the engine family meets the criteria, k is calculated for hydrocarbons, CO and NOx, according to Section I.C. The sample size is 50 for the next quarter if all three k_s-k_i's are equal to or greater than 2. If i is less than 2, the sample size will be a minimum of two percent.

II. General Procedure Explanation

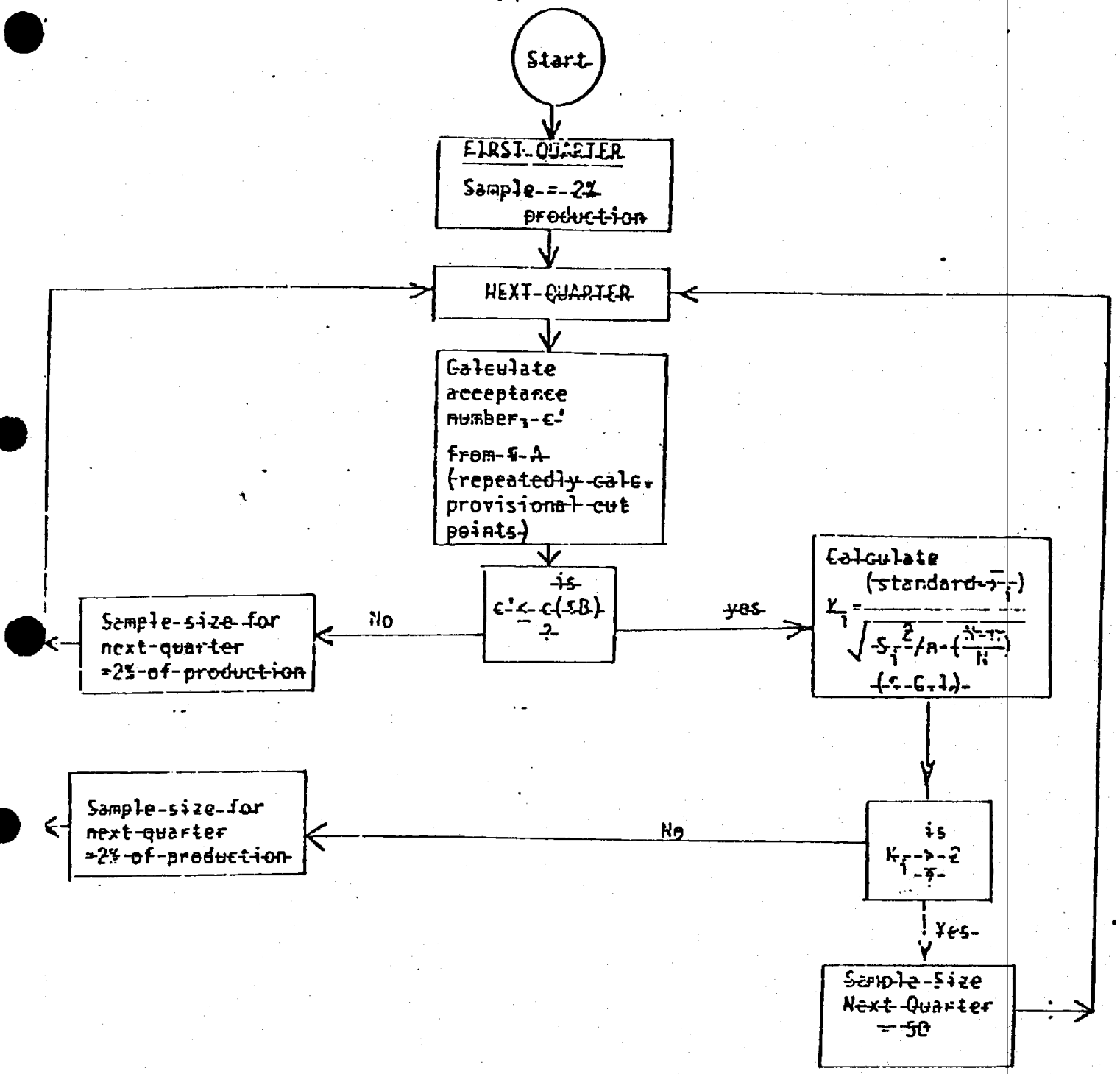
The overall procedure for determining the next quarter's quality audit sampling rate is presented in a flow diagram in Figure 1. The flow sheet is for a period of one model year.

The sampling rate is a 2% minimum of production for all manufacturers for the first quarter. The sampling rate may be reduced for the following quarters when the criteria for excellence of quality control is met the previous quarter using the calculations of Section I. The acceptance number c_1 is calculated for the current quarter as per Section I.A. The table in Section I.B. is entered to find the allowable acceptance number c for the sample size of the current quarter. If the acceptance number c_1 is equal to or less than the allowable acceptance number c for HC, CO and NOx, then that engine family may meet the criteria for excellence of quality control. If the engine family does not meet these criteria, the sample size for the next quarter for that engine family shall be 2% of the next quarter's production.

If the engine family meets the criteria, k is calculated for hydrocarbons, CO and NOx, according to Section I.C. The sample size is 50 for the next quarter if all three k_s K_i's are equal to or greater than 2. If i is less than 2, the sample size will be a minimum of two percent.

FIGURE 1

PROCEDURE TO DETERMINE QUALITY AUDIT SAMPLE SIZE



APPENDIX A

Alternate Quality Audit Vehicle Selection Criteria

This Appendix sets forth the alternative procedure for selection of Quality Audit vehicles. It includes the flow diagram in Figure A-1.

1. Vehicles shall be randomly selected at a rate of 2.0% of engine family production at the beginning of production. When tests results of 30 vehicles have been accumulated, an evaluation as indicated below shall be made.

2. Calculate the family mean and standard deviation of each pollutant (HC, CO, NOx). Identify vehicles which have emission levels greater than three standard deviations above the mean. Eliminate these emission data points and recalculate the mean and standard deviation. Continue the calculation until there are no values greater than three standard deviations above the mean. Count the number of these data points greater than the standard (outliers). If the number of outliers is equal to or less than the allowable number in Table A-1 for each pollutant, the engine family is eligible to continue to a second evaluation shown in paragraph 3 below. Otherwise, sampling must continue at a rate of 2.0% of production for the rest of the month.

3. If the allowable outlier criteria is met, the family mean, standard deviation, and sample size determined for each contaminant before excluding any outliers, is substituted in the following expression:

$$\frac{(\text{emission standard} - \text{mean})\ (\sqrt{N})}{(\text{standard deviation})}$$

If the expression is greater than C in Table A-2 below, and the manufacturer reasonably estimates that the quarterly engine family production will exceed 5,000 vehicles, the sampling rate for the remaining portion of the calendar month following the date of selection of the last of the 30 vehicles shall be 30 per month, applied on a prorated basis. If the expression is greater than C in Table A-2 below, and the manufacturer reasonably estimates that the quarterly engine family production will be 5,000 vehicles or less, the sampling rate for the remaining portion of the calendar month following the date of selection of the last of the 30 vehicles shall be 17 per month, applied on a prorated basis. If the expression is equal to or less than C in Table A-2, the sampling rate shall continue to be 2.0% of production for the remaining portion of the month in which selection of the 30 vehicles is completed. The value of C is a function of the coefficient of variation (standard deviation/mean). The coefficient of variation and "C" shall be rounded to the number of decimal places shown in Table A-2.

Table A-1

Sample Size	Allowable Outliers	Sample Size	Allowable Outliers
30-60	0	521-540	20
61-90	1	541-570	21
91-120	2	571-590	22
121-140	3	591-610	23
141-170	4	611-630	24
171-190	5	631-660	25
191-220	6	661-680	26
221-240	7	681-700	27
241-270	8	701-720	28
271-290	9	721-750	29
291-310	10	751-770	30
311-340	11	771-790	31
341-360	12	791-810	32
361-380	13	811-840	33
381-410	14	841-860	34
411-430	15	861-880	35
431-450	16	881-900	36
451-480	17	901-920	37
481-500	18		
501-520	19		

1-32	1	430-478	11
33-68	2	479-528	12
69-107	3	529-578	13
108-149	4	579-629	14
150-193	5	630-680	15
194-238	6	681-731	16
239-285	7	732-783	17
286-332	8	784-835	18
333-380	9	836-887	19
381-429	10	888-939	20

Table A-2

Coefficient of Variation	C
0.1	0.5
0.2	1.2
0.3	1.8
0.4	2.5
0.5	3.1
0.6	3.8
0.7	4.4
0.8	5.1
0.9	5.7

4. For each remaining calendar month in the quarter, both mathematical procedures set forth in paragraphs 2 and 3 shall be repeated at the end of the preceding month, using all of the test data accumulated in the quarter. The sampling rate for each remaining calendar month in the quarter shall be 30 vehicles per month, 17 vehicles per month, or 2.0% of production as determined under the standards in paragraph 3.

5. At the end of the quarter, all of the data accumulated during the quarter is evaluated, and the compliance of the family with emission standards is determined.

6. For each subsequent quarter, the preceding sample selection method shall be followed. The sample rate determination for the first month of each subsequent quarter shall be based on the accumulated data from the previous quarter. The sample rate for the succeeding months of the quarter shall be determined as previously set forth.

7. If the start of production does not coincide with the first of a quarter, the sequence for sample rate determination shall be followed, but references to remaining calendar months may not be appropriate.

8. Where a manufacturer has sampled vehicles at a rate of 17 per month following a reasonable estimate that the quarterly engine family production will be 5,000 vehicles or less, and subsequently determines, or reasonably should determine based on information available to the manufacturer, that the quarterly engine family production will exceed 5,000 vehicles, the manufacturer shall increase the sampling rate for the quarter such that the requirements of paragraph 3 applicable to families reasonably estimated to exceed a quarterly production of 5,000 vehicles are satisfied.

FIGURE A-1

FIRST QUARTER OF PROD.:

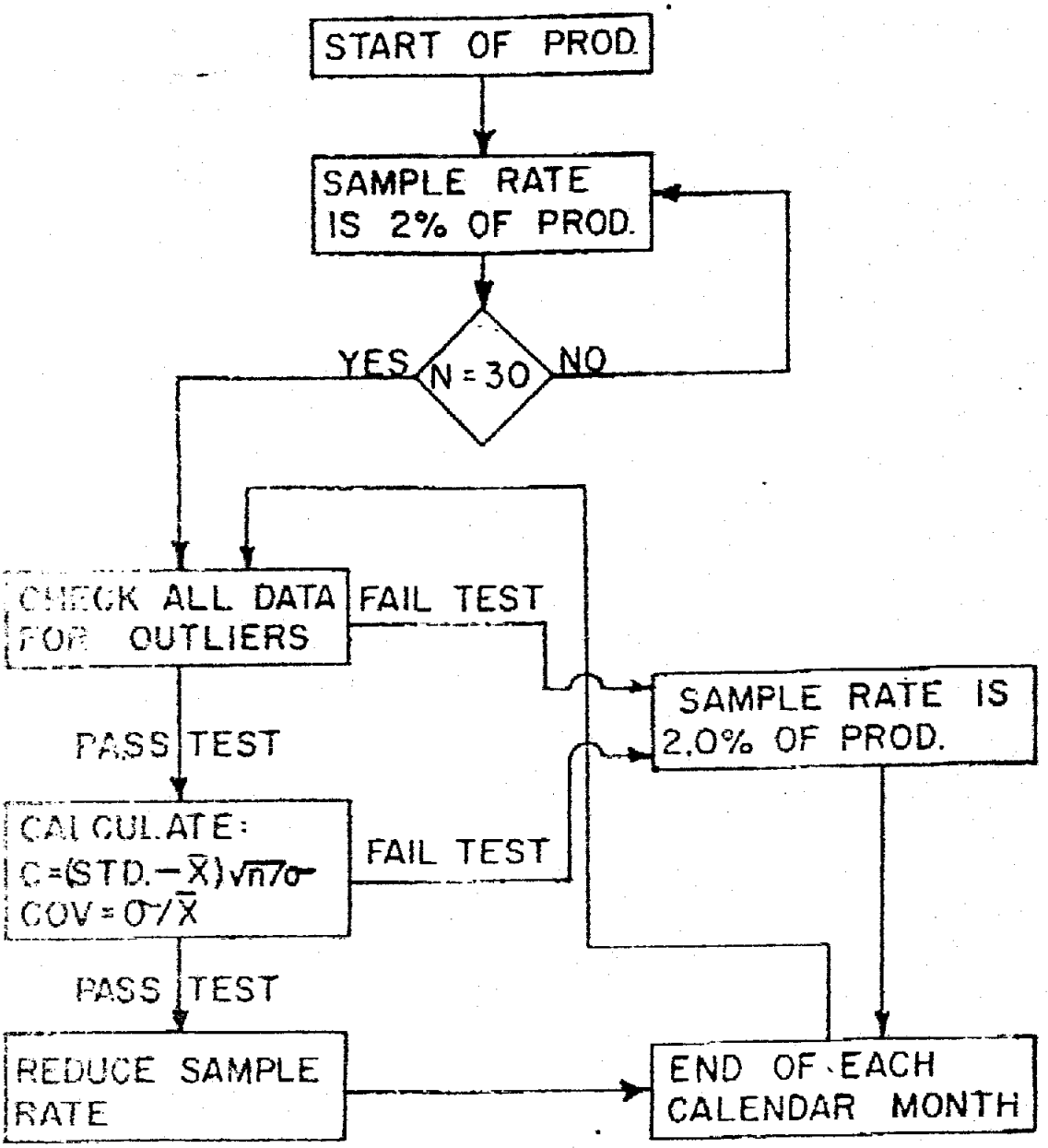


FIGURE A-1

SUBSEQUENT QUARTERS

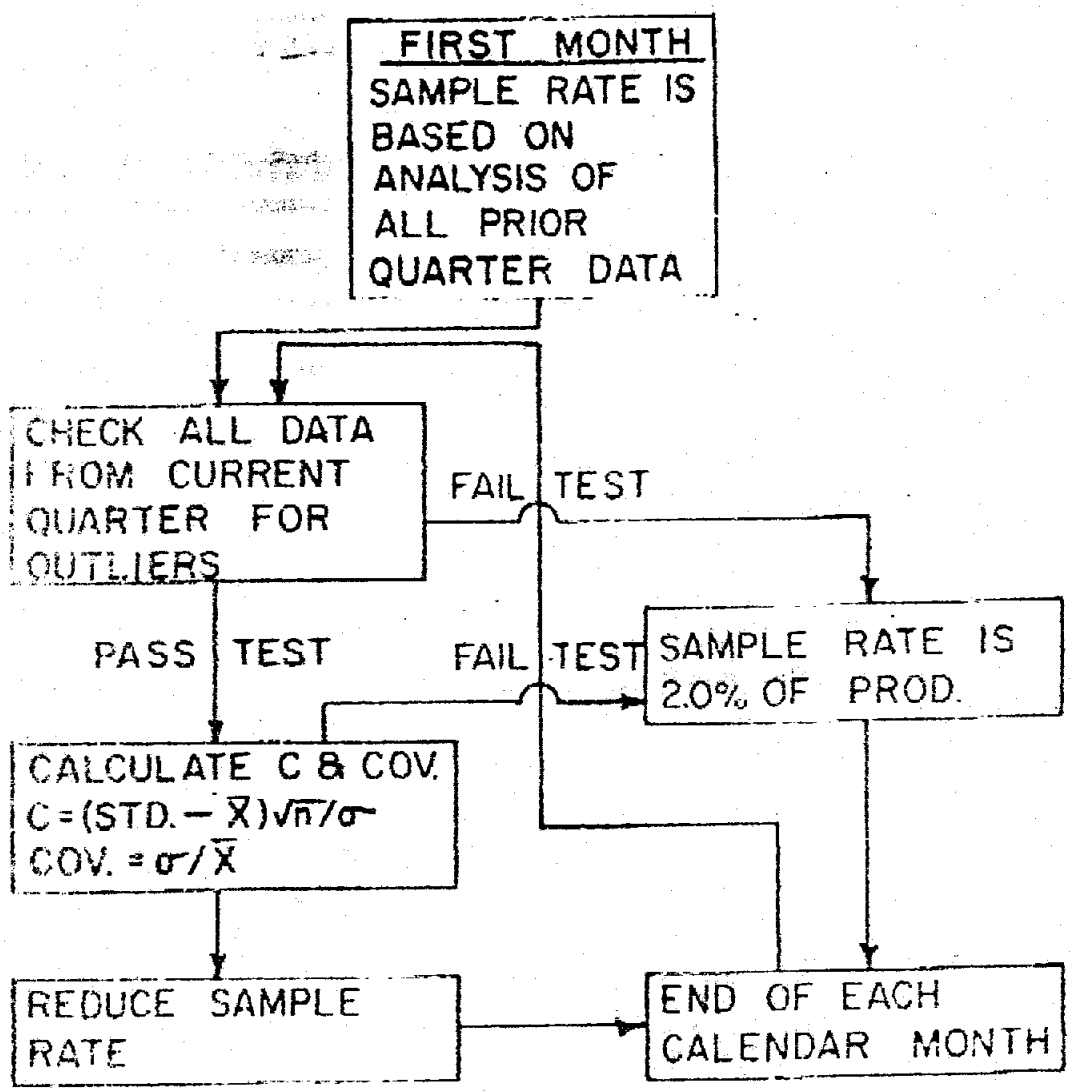
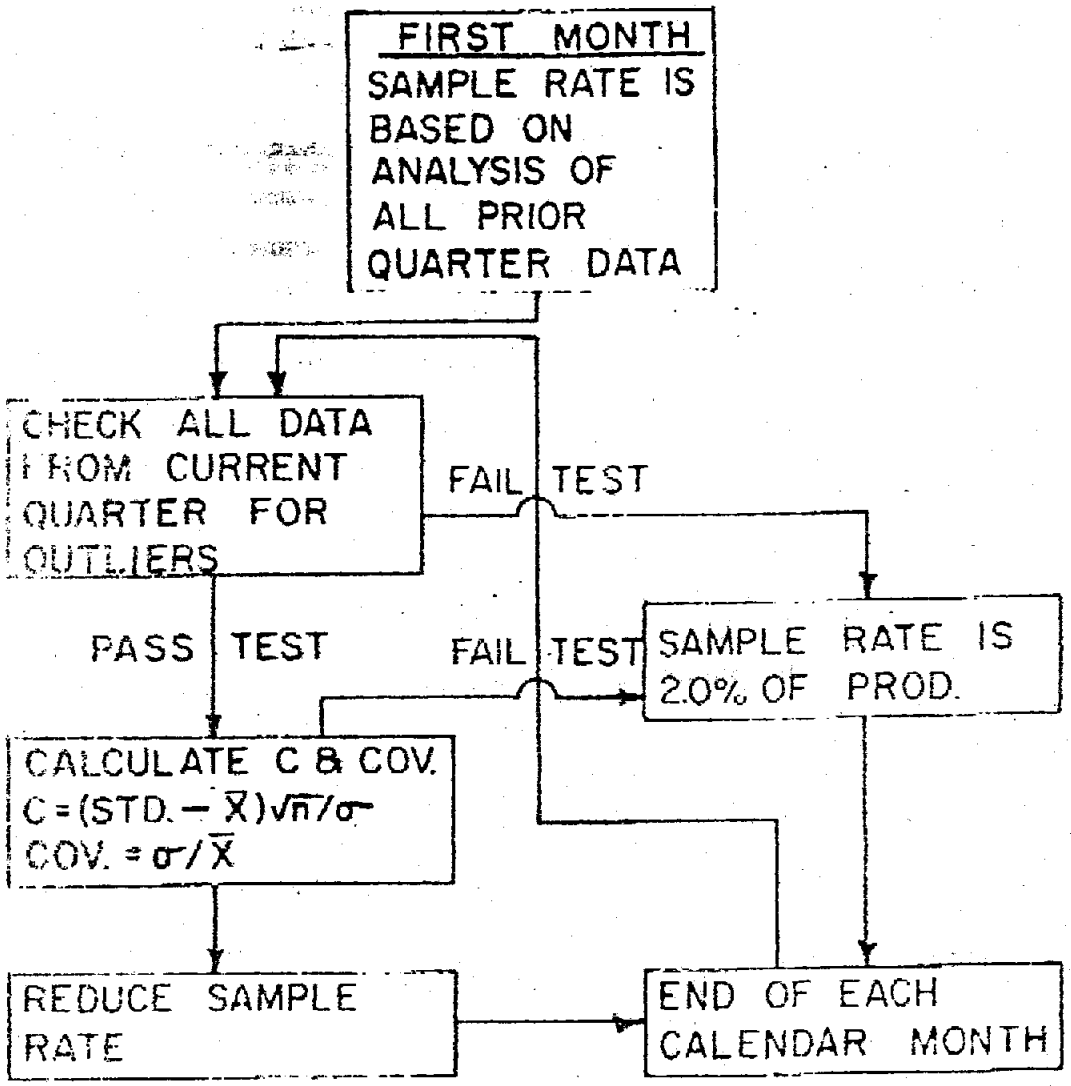


FIGURE A-1

SUBSEQUENT QUARTERS



05-1

FIGURE A-1

OUTLIER CALCULATION PROCEDURE

1. CALCULATE THE MEAN AND STANDARD DEVIATION FOR EACH POLLUTANT WITH DF APPLIED.
2. CALCULATE THE MEAN PLUS THREE STANDARD DEVIATIONS.
3. IDENTIFY ALL EMISSION DATA GREATER THAN $\bar{X} + 3\sigma$.
4. REMOVE THE OUTLIERS FROM THE DATA AND RECALCULATE THE MEAN AND STANDARD DEVIATION.
5. REPEAT STEPS 2, 3, & 4
6. REPEAT STEPS 2 & 3
7. IDENTIFY ALL OUTLIERS THAT EXCEED APPLICABLE CERTIFICATION STANDARD AND COUNT THE NUMBER.
8. COMPARE THE NUMBER OF OUTLIERS WITH THE MAXIMUM ALLOWED BY THE OUTLIER TABLE. IF THE NUMBER OF OUTLIERS EXCEEDS THE MAXIMUM, SAMPLE RATE IS 2.0% OF PRODUCTION. IF THE NUMBER IS LESS THAN THE MAXIMUM ALLOWED, CALCULATE "C".

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Amendments to Assembly-Line Test Procedures for Certain 1983 and Subsequent Model Year Vehicles, Regarding Quality Audit Vehicle Sample Selection, and Adoption of Amendments to Title 13, California Administrative Code, Section 2061, Incorporating the Test Procedures

Agenda Item No.: 83-4-3

Public Hearing Date: April 20, 1983

Response Date: May 12, 1983

Issuing Authority: Executive Officer

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no adverse environmental effects.

Response: N/A

CERTIFIED: _____
Executive Officer

Date: Sept. 8, 1983

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Public Hearing to Consider Amendments to the Assembly-Line Test Procedures for Certain 1983 and Subsequent Model Year Vehicles, Regarding Quality Audit Vehicle Sample Selection, and Adoption of Amendments to Title 13, California Administrative Code, Section 2061, Incorporating the Test Procedures

Hearing Date: April 20, 1983
Public Availability Date: April 27, 1983

On April 20, 1983, the Air Resources Board approved amendments to its "California Assembly-Line Test Procedures for 1983 and Subsequent Model Year Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles", and to Section 2061, Title 13, California Administrative Code, which establishes the test procedures. Attached is a copy of the Board's Resolution 83-3, approving these amendments.

The approved amendments were identical to those previously proposed by staff, with the exception of certain modifications to the contents of Appendix A of the Test Procedures. Appended to Resolution 83-3 are the approved Test Procedures, showing deletions from the original proposed language of Appendix A in slashes, and additions in double underline. Also attached are the approved amendments to Section 2061 of Title 13, California Administrative Code.

In approving the amendments to the Test Procedures and Section 2061, the Board directed the Executive Officer to adopt the amendments after making them available to the public for a period of 15 days, provided, however, that the Executive Officer shall consider such written comments as may be submitted during this period, and shall present the regulations to the Board for further consideration if he determines that this is warranted in light of the written comments received. Any written comments must be received by May 12, 1983, to be considered.

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject: Filing of Notice of Decisions of the Air Resources Board

From : Harold Holmes
Board Secretary
Air Resources Board

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
Resolution 83-3
Resolution 83-7
Resolution 83-8

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution No. 83-4

April 20, 1983

Agenda Item No. 83-4-4

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board (Board) to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Section 43107 of the Health and Safety Code authorizes the Board to adopt emission standards and test procedures in order to control air pollution from new 1977 and later model year motorcycles registered or sold in California;

WHEREAS, after public hearing and other administrative proceedings in accordance with the provisions of the Administrative Procedure Act, in 1975 the Board adopted a hydrocarbon (HC) exhaust emission standard of 1.0 gram per kilometer (g/km) for 1982 and subsequent model year California certified Class III motorcycles (280 cubic centimeters and larger), and in 1980, in response to petitions from motorcycle manufacturers, the Board adopted an interim standard and delayed the application of the 1.0 g/km HC exhaust emission standard until 1984 for Class III motorcycles;

WHEREAS, in October and December 1982 the Board held hearings to consider petitions filed by several motorcycle manufacturers requesting changes to the 1984 Class III motorcycle HC exhaust emission standard, and determined to grant partial relief from the 1984 1.0 g/km HC standard for some manufacturers and otherwise to deny the petitions;

WHEREAS, at the conclusion of the proceedings on the motorcycle manufacturers' petitions the Board adopted Resolution No. 82-53 and found among other things that:

> The existing 1.0 g/km HC exhaust emission standard for Class III motorcycles for 1984 and subsequent model years is necessary and technologically feasible;
>
> For small volume motorcycle manufacturers only, providing up to three additional years for compliance with the 1.0 g/km HC exhaust emission standard for Class III motorcycles is appropriate considering the relative cost impacts of the standard on these manufacturers compared to others, and the continuing development but currently limited commercial availability of appropriate catalyst HC control technology for these manufacturers; and

Based on durability data submitted by motorcycle manufacturers which currently sell the majority of motorcycles in California, durable catalyst systems exist or with some design or engineering modifications can be made available and appropriate for installation on Class III motorcycles.

WHEREAS, the Board has defined a small volume motorcycle manufacturer as one which sells fewer than 5,000 motorcycles (Classes I, II, and III combined) annually in California;

WHEREAS, the Board directed the staff to develop a proposal providing small volume motorcycle manufacturers an extension of the date for compliance with the 1.0 g/km HC exhaust emission standard for Class III motorcycles;

WHEREAS, the California Environmental Quality Act and Board regulations require that an activity not be adopted as proposed where the activity will have significant adverse environmental impacts and alternatives or feasible mitigation measures to the proposed activity exist which would substantially reduce such impacts;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code;

WHEREAS, the Board finds that:

A maximum potential estimated impact of 0.3 ton per day statewide loss of HC control in 1986 could result from the proposed small volume motorcycle manufacturers exemption;

During the period of exemption an interim HC exhaust emission standard of 2.5 g/km will continue to apply for new Class III motorcycles produced by small volume motorcycle manufacturers, and additional feasible mitigation measures do not exist to reduce the potential emission impact from the adoption of a small volume motorcycle manufacturers exemption for new Class III motorcycles;

The proposed regulations include all feasible measures to mitigate any potential adverse effects on air quality and will not have significant adverse effects on other environmental resources.

NOW, THEREFORE, BE IT RESOLVED that the Board amends the regulations in Article 2, Subchapter 1, Chapter 3, Title 13 of the California Administrative Code, by adopting Section 1958(g) as set forth in Attachment A hereto.

BE IT FURTHER RESOLVED that the Board hereby determines that the regulations adopted herein in the aggregate are at least as protective of public health and welfare as applicable federal standards and are consistent with Sections 202(a) and (b) of the federal Clean Air Act.

I hereby certify that the above is a true and correct copy of Resolution 83-4, as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

Attachment A

Proposed Adoption of Section 1958(g), Chapter 3, Title 13, California Administrative Code

(g) (1) Exhaust emissions from Class III motorcycles of small volume manufacturers shall not exceed 2.5 grams per kilometer hydrocarbon for the 1984, 1985, and 1986 model years. The manufacturer shall submit product information and estimated sales data with the certification application for each engine family sold in California. On or before July 1, 1983, and annually thereafter for the following three years, the manufacturer shall submit to the state board a summary of its efforts and progress toward meeting more stringent hydrocarbon exhaust emission standards.

(2) For purposes of this subsection, a small volume manufacturer is one which sells or was in the process of obtaining certification to sell as of December 1, 1982, less than 5,000 new motorcycles per year in California.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: PUBLIC HEARING TO CONSIDER AMENDMENTS TO TITLE 13, CALIFORNIA ADMINISTRATIVE CODE, SECTION 1958(g), REGARDING AN EXTENSION OF THE DATE FOR COMPLIANCE WITH CLASS III MOTORCYCLE 1.0 GRAM PER KILOMETER HYDROCARBON EXHAUST EMISSION STANDARD FOR SPECIFIED SMALL VOLUME MANUFACTURERS

Agenda Item No.: 83-4-4

Public Hearing Date: April 20, 1983

Response Date: April 20, 1983

Issuing Authority: Air Resources Board

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report and Board Resolution No. 83-4 identified a maximum potential statewide hydrocarbon emission increase of 0.3 tons per day in 1986. Other than the required 2.5 g/km interim standard for manufacturers receiving an exemption, no feasible mitigation measures exist to reduce the potential emission impact.

Response: None

CERTIFIED: Harold Johnson
Board Secretary

Date: 10-20-83

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : May 5, 1983

Subject: Filing of Notice of
Decisions of the Ai
Resources Board

From : Harold Holmes
Board Secretary
Air Resources Board

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

Attachments
Resolution 82-63
Resolution 83-4

State of California
AIR RESOURCES BOARD

Resolution 83-6

April 21, 1983

Agenda Item No.: 83-5-1

WHEREAS, the Legislature has determined that acid deposition in California has the potential for significant adverse effects on the environment, on the economy, and on public health;

WHEREAS, the Legislature, pursuant to the Kapiloff Acid Deposition Act (Stats. 1982, ch. 1473), has directed the Air Resources Board to coordinate and collect research and monitoring data on acid deposition;

WHEREAS, the Air Resources Board has conducted a Symposium on Acid Rain in California and has conducted and funded initial monitoring and research studies which indicate that acid deposition, including acid rain, acid fog and other forms of acid precipitation, occur at various times and locations throughout California;

WHEREAS, research goals and objectives regarding acid deposition and the corresponding research and monitoring needs have been established as required by the Kapiloff Acid Deposition Act;

WHEREAS, a proposed program for priority research and monitoring has been developed and has been endorsed by the State Agency Working Group on Acid Deposition; and

WHEREAS, the Legislature, pursuant to the Kapiloff Acid Deposition Act, has authorized the Air Resources Board to require local air pollution control districts and air quality management districts, beginning July 1, 1983, to impose additional variance and permit fees on non-vehicular sources, in order to recover a portion of the costs of the acid deposition research and monitoring program.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board intends to consider a proposal to establish, and require districts to adopt, an acid deposition fee program in Fiscal Year 1983-84, as authorized by the Kapiloff Act (Health and Safety Code Section 39910).

BE IT FURTHER RESOLVED that such fee program shall be designed to provide a portion of the revenue needed for the Board's acid deposition research and monitoring program, and that the fee schedule shall be designed to provide to the Air Pollution Control Fund net revenues in Fiscal Year 1983-84 of an amount which is the lesser of either one million dollars, or the amount that is appropriated for acid deposition research and monitoring by the Legislature.

BE IT FURTHER RESOLVED that the Executive Officer, in cooperation with air pollution control districts, shall develop a detailed fee schedule and program to meet the objectives set forth above and shall schedule such proposal for consideration by the Board as expeditiously as practicable.

I hereby certify that the above is a true and correct copy of Resolution 83-6, as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

Resolution 83-7

May 26, 1983

Agenda Item No.: 83-6-1

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board (the "Board") to adopt standards, rules and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Section 41850 of the Health and Safety Code provides that agricultural burning be reasonably regulated and not be prohibited;

WHEREAS, Section 41855 of the Health and Safety Code requires the Board to determine and designate from meteorological data the days when agricultural burning shall be prohibited in each air basin;

WHEREAS, Sections 41856 and 41857 of the Health and Safety Code direct the Board to promulgate guidelines for the regulation and control of agricultural burning for each air basin which are based on meteorological data, the nature and volume of materials to be burned, and the probable effect of such burning on the ambient air quality within the basins affected;

WHEREAS, Section 41858 of the Health and Safety Code provides that, in adopting the guidelines, the Board shall consider their economic and technical feasibility, including their probable effect on agricultural production in the air basin affected;

WHEREAS, Section 41859 of the Health and Safety Code provides that the Board shall continuously review the guidelines it has promulgated and may modify, repeal, or alter such guidelines if scientific and technological data indicate that such changes are warranted;

WHEREAS, Section 41863 of the Health and Safety Code provides that each basinwide coordinating council and district shall include a component for the regulation and control of agricultural burning pursuant to the Board's guidelines in its implementation plan and program;

WHEREAS, the Board has established Agricultural Burning Guidelines and Meteorological Criteria in Sections 80100-80330 of Title 17, California Administrative Code;

WHEREAS, under Sections 80150, 80250, and 80320 of Title 17, California Administrative Code, agricultural burning in the Sacramento Valley Air Basin and the portion of Placer County under 1,500 feet msl elevation (collectively the "Sacramento Valley Air Basin") is subject to nonvariable acreage limitations on permissive burn days;

WHEREAS, Board staff has developed, in coordination with the Sacramento Valley Basinwide Air Pollution Control Council and its Technical Advisory Committee, proposed amendments to Sections 80150, 80250, and 80320 of Title 17, California Administrative Code, which would vary on a daily basis the maximum number of acres that can be burned in the Sacramento Valley Air Basin on permissive burn days based on existing and expected meteorological and air quality conditions, and which would provide for establishing daily acreage limits in each of the districts in the Sacramento Valley Air Basin;

WHEREAS, the amendments proposed by Board staff would establish a regulatory program similar to the test agricultural burning program now in effect in the Sacramento Valley Air Basin;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project having significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code; and

WHEREAS, the Board finds that:

The amendments to the Agricultural Burning Guidelines and Meteorological Criteria for the Sacramento Valley Air Basin set forth in Attachment A provide for a system of daily variable acreage allocations and prorations among the districts in the basin which will be more closely matched to meteorological conditions and the probable effect of burning on air quality within the basin;

This system is likely to improve the air quality in the basin and reduce the incidence of smoke intrusions into urban areas;

This system is likely to increase the number of days on which some agricultural burning is permitted in the air basin and therefore is likely to provide more flexibility to local control personnel and farmers to schedule agricultural burning;

This system is likely to result in increased burning efficiency for farmers on days when it is not too wet to burn; and

The amendments set forth in Attachment A will have no significant adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves the amendments to Title 17, California Administrative Code, Sections 80150, 80250, and 80320 set forth in Attachment A hereto.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to adopt the amendments set forth in Attachment A after making them available to the public for a period of 15 days, provided, however, that the Executive Officer shall consider such written comments as may be submitted during this period, and shall present the regulations to the Board for further consideration if he determines that this is warranted in light of the written comments received.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to work with the air pollution control districts in the Sacramento Valley Air Basin and the agricultural community to assist the districts in securing continued funding for administration of the Sacramento Valley Air Basin agricultural burning program.

I certify that the above is a true and correct copy of Resolution 83-7, as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

80150. Open Burning in Agricultural Operations in the Growing of Crops or Raising of Fowl or Animals. (a) A district with no agricultural operations in the growing of crops or raising of fowl or animals within its jurisdiction may request to be exempted from the requirements of this section.

(b) Where an implementation plan for open burning in agricultural operations in the growing of crops or raising of fowl or animals is required, the plan shall include rules and regulations which:

(1) Require the material to be burned to be free of material that is not produced in an agricultural operation.

(2) Require the material to be arranged so that it will burn with a minimum of smoke.

(3) Require material to be reasonably free of dirt, soil and visible surface moisture.

(4) Require the material to be dried for minimum periods to be specified in the implementation plan, with separate specifications for the following: (A) trees and large branches, (B) prunings and small branches, (C) wastes from field crops that are cut in a green condition, and (D) other materials.

(5) Regulate the total amount of material that may be burned each day.

(c) In developing the rules and regulations each district shall consider additional provisions with respect to the following:

(1) Hours of burning.

(2) No-burning season or seasons.

(3) Regulating burning when the wind direction is toward a nearby populated area.

(4) Limiting the ignition of fires to approved ignition devices.

(5) Permitting on no-burn days the burning of empty sacks or containers which contained pesticides or other toxic substances, providing the sacks or containers are within the definition of "open burning in agricultural operations in the growing of crops or raising of fowl or animals," as specified in Section 80100~~(g)~~(f)(2)(B).

(d) Districts within the boundaries of the Sacramento Valley Air Basin and that portion of Placer County (of the Mountain Counties Air Basin) below 1,500 feet msl, and districts within the boundaries of the San Joaquin Valley Air Basin, shall include in the plan rules and regulations which:

(1) Require all rice harvesting to employ a mechanical straw spreader to ensure even distribution of the straw with the following exception:

(A) Rice straw may be left in rows provided it meets drying time criteria prior to a burn as described in subdivision (d)(2) below.

(2) Require that after harvest

(A) No spread rice straw shall be burned prior to a three day drying period.

(B) No rowed rice straw shall be burned prior to a ten day drying period.

(C) Subdivisions (d)(2)(A) and (d)(2)(B) above do not apply if the rice straw makes an audible crackle when tested just prior to burning with the testing method described in subdivision (d)(2)(D) of these provisions.

(D) When checking the field for moisture, a composite sample of straw from under the mat, in the center of the mat and from different areas of the field shall be taken to insure a representative sample. A handful of straw from each area will give a good indication. Rice straw is dry enough to burn if a handful of straw selected as described above crackles when it is bent sharply.

(E) After a rain exceeding 0.15 inch (fifteen hundredths of an inch), notwithstanding subdivisions (d)(2)(A) and (B) above, rice straw shall not be burned unless the straw makes an audible crackle when tested just prior to burning with the testing method described in subdivision (d)(2)(D), above.

(3) Require rice, barley, oat and wheat straw to be ignited only by stripfiring into-the-wind or by backfiring except under a special permit of the district issued when and where extreme fire hazards are declared by a public fire protection agency to exist, or where crops are determined not to lend themselves to these techniques.

(4) Require burning hours to be set so that no field crop burning shall commence before 10:00 a.m. nor after 5:00 p.m. of any day.

~~(e)--In-addition-to-the-regulations-required-in-subdivision-(d),-above, districts-within-the-boundaries-of-the-Sacramento-Valley-Air-Basin-shall also-include-in-the-plan-rules-and-regulations-which:~~

~~(1)--Require-that-during-the-critical-period-from-October-1-through November-15-of-each-year,-the-daily-acreage,-on-permissive-burn-days,-of open-burning-in-agricultural-operations-in-the-growing-of-crops-or-raising of-fowl-or-animals-within-the-basin-shall-be-no-more-than-that-amount-which would-result-in-particulate-emissions-of-335-tons-per-day.--For-the-purpose of-evaluating-emissions-pursuant-to-this-section,-the-emission-factors included-in-Attachment-A-(Section-80155)-shall-be-used.--The-authority-for determining-how-the-acreage-will-be-allotted-to-each-crop-waste-and-to-each district-shall-rest-with-the-Sacramento-Valley-Basinwide-Control-Council, provided-that-the-Council-may-not-allocate-to-any-district-an-amount-of acreage-which-would-result-in-total-particulate-emissions-in-excess-of-335 tons-per-day-Basinwide-if-each-district-within-the-Basin-were-permitted-to~~

~~burn.--The-crop-and-district-allocations-prepared-by-the-Basinwide-Control Council-shall-be-submitted-to-the-Chief-of-the-Air-Resources-Board Enforcement-Branch-by-September-15-of-each-year.~~

(e) The Sacramento Valley Basinwide Air Pollution Control Council shall submit an Agricultural Burning Plan for the 12-month period commencing September 1 to the state board by July 1 of each year for the state board's review and approval. The Agricultural Burning Plan shall be developed in cooperation with state board staff. It shall be applicable to all areas of the Sacramento Valley Air Basin below 3,000 feet msl, and to that portion of Placer County (in the Mountain Counties Air Basin) below 1,500 feet msl. It shall contain:

(1) A daily basinwide acreage allocation equation which includes a basinwide meteorological factor (B.M.F. - determined from Tables 4, 5, and 6 of Section 80320) and a basinwide air quality factor (B.A.Q.F. - basinwide 24-hour average soiling index at decision time);

(2) Procedures for distributing acreage allocations to each district, the total of which shall not exceed the basinwide acreage allocation determined by the state board from the daily basinwide acreage allocation equation;

(3) The hours to be permitted for burning;

(4) a description of the meteorological and air quality monitoring networks to be used to provide data for determining the basinwide meteorological and air quality factors; and

(5) Other clarifying details mutually agreed upon by the Basinwide Council and the state board.

The executive officer of the state board shall approve the plan if s/he determines it meets the requirements of this subdivision (e) and contains a basinwide acreage allocation equation that, when applied, is not likely to permit emissions from agricultural burning which cause or contribute to a violation of the state ambient air quality standard for suspended particulate matter or a significant deterioration of existing air quality. The approved Agricultural Burning Plan shall remain in effect until the executive officer approves a new plan.

(f) In addition to the regulations required in subdivision (d) above, districts within the boundaries of the Sacramento Valley Air Basin and that portion of Placer County (of the Mountain Counties Air Basin) below 1,500 feet msl shall also include in the plan rules and regulations which, for all areas below 3,000 feet msl:

(1) Require that the daily acreage, on permissive-burn days, of open burning in agricultural operations in the growing of crops or raising of fowl or animals within the district shall be no more than that acreage determined by the state board from the daily basinwide acreage allocation equation contained in the approved Agricultural Burning Plan required by subdivision (e) above and distributed to the district in accordance with the approved Agricultural Burning Plan. The allocation determined by the state board shall be in rice acre equivalents. The factors given in Attachment A (Section 80155) shall be used to convert other crop wastes to equivalent rice acre allocations.

(2) Require that no crop acreage which was harvested prior to September 10 shall be allowed to be burned during the period October 1 through November 15 of each year, unless written authority is given by the district.

In granting such written authority the district shall:

(A) Ensure the amount of acreage which is to be burned shall be included in the district's allotment specified in (1) above.

(B) Require a specific explanation of the cultural practices which require immediate burning.

(C) Require the person to specify the reason why burning was not conducted prior to October 1.

(D) Require the exception to be valid only on permissive-burn days.

NOTE: Authority cited: Sections 39600, 39601, 41856, and 41859, Health and Safety Code. Reference: Sections 41856, 41857, 41858, 41859, and 41863, Health and Safety Code.

80250. Sacramento Valley Air Basin and the Portion of Placer County below 1,500 Feet msl. (a) Above 3,000 feet msl*, a permissive-burn day will be declared when the following criteria are met:

(1) Near 4:00 a.m., the mean 500 mb height over the Basin is less than the limiting mean height given in Table 1 of Section 80320.

(2) The expected 4:00 p.m. mean 500 mb height over the Basin is less than the limiting mean height given in Table 1 of Section 80320.

~~(b) Below 3,000 feet msl*, in the counties of Shasta, Tehama, Butte, and Glenn (North Section of Basin), a permissive-burn day will be declared when at least 3 of the following criteria are met:~~

~~(1) Near the time of day when the surface temperature is at a minimum, the temperature at 3,000 feet above the surface is not warmer than the surface temperature by more than 8 degrees Fahrenheit.~~

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* In place of the standard 3,000 feel msl level, the elevation may be specified in increments of 500 feet on a day-to-day basis as determined from vertical temperature soundings.

(2)--The-expected-daytime-temperature-at-3,000-feet-above-the surface-is-colder-than-the-expected-surface-temperature-by-at-least-11 degrees-Fahrenheit-for-4-hours.

(3)--The-expected-daytime-wind-speed-at-3,000-feet-above-the surface-is-at-least-5-miles-per-hour.

(4)--The-expected-daytime-wind-direction-in-the-mixing-layer-has-a component-from-the-south.

(c)--Below-3,000-feet-msl*,-in-the-counties-of-Colusa,-Yolo,-and-Solano (Southwest-Section-of-Basin),-a-permissive-burn-day-will-be-declared-when-at least-3-of-the-following-criteria-are-met:

(1)--Near-the-time-of-day-when-the-surface-temperature-is-at-a minimum,-the-temperature-at-3,000-feet-above-the-surface-is-not-warmer-than the-surface-temperature-by-more-than-13-degrees-Fahrenheit.

(2)--The-expected-temperature-at-3,000-feet-above-the-surface-is colder-than-the-expected-surface-temperature-by-at-least-11-degrees Fahrenheit-for-4-hours.

(3)--The-expected-daytime-wind-speed-at-3,000-feet-above-the surface-is-at-least-5-miles-per-hour.

(4)--The-expected-daytime-wind-direction-in-the-mixing-layer-has-a component-from-the-south-or-from-the-east.

(d)--Below-3,000-feet-msl*,-in-the-counties-of-Sacramento,-Sutter,-and Yuba-(Southeast-Section-of-Basin),-and-that-portion-of-Placer-County-(of-the Mountain-Counties-Air-Basin)-below-1,500-feet-msl,-a-permissive-burn-day will-be-declared-when-at-least-3-of-the-following-criteria-are-met:

(1)--Near-the-time-of-day-when-the-surface-temperature-is-at-a

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*-Ibid

~~minimum,-the-temperature-at-3,000-feet-above-the-surface-is-not-warmer-than the-surface-temperature-by-more-than-13-degrees-Fahrenheit.~~

~~(2)--The-expected-temperature-at-3,000-feet-above-the-surface-is colder-than-the-expected-surface-temperature-by-at-least-11-degrees Fahrenheit-for-4-hours.~~

~~(3)--The-expected-daytime-wind-speed-at-3,000-feet-above-the surface-is-at-least-5-miles-per-hour.~~

~~(4)--The-expected-daytime-wind-direction-in-the-mixing-layer-has-a component-from-the-south.~~

(b) Below 3,000 feet msl*, in all counties of the Basin and that portion of Placer County (of the Mountain Counties Air Basin) below 1,500 feet msl, a permissive-burn day will be declared when the daily basinwide acreage allocation is greater than zero acreage. This allocation shall be determined daily by the state board and will vary with the existing and projected meteorology and air quality. The basinwide allocation shall be calculated from the basinwide acreage allocation equation contained in the approved Agricultural Burning Plan required in Section 80150(e).

~~(e)~~(c) Special situations in the Basin are:

(1) Burning control notices for certain specific burning operations may be issued up to 48 hours in advance. In such a case, the criteria used will be a modification of the above criteria so as to give consideration to the

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* Ibid

specific site and its location relative to populous areas, the stated amount of material to be burned, and the expected impact that the burn will have on air quality.

~~(2)--Except-for-the-period-October-1-through-November-15-of each-year,-a-premium-permissive-burn-day-will-be-declared-when-the conditions-for-a-permissive-burn-day-above-are-met-and-near-the-time-of-day when-the-surface-temperature-is-at-a-minimum,-the-temperature-at-3,000-feet above-the-surface-is-not-warmer-than-the-surface-temperature-by-more-than-5 degrees-Fahrenheit.~~

~~(3)~~(2) If, when a no-burn day decision is declared, the federal ambient air quality standard for ozone, carbon monoxide, hydrocarbons, total suspended particulate, or state visibility standard is expected to be exceeded during the valid period, a note to this effect will be appended to the announcement.

~~(4)~~(3) A permissive-burn or no-burn day decision that has been announced may be changed by the Air Resources Board at any time prior to 10:00 a.m. if the meteorological and air quality situation that actually unfolds so warrants it.

NOTE: Authority cited: Sections 39600, 39601, 41856, and 41859, Health and Safety Code. Reference: Sections 41854, 41855, 41856, 41857, 41859, and 41863, Health and Safety Code.

80320. Tables Referred to in Article 3.

Limiting mean 500-millibar heights*, by month

	Table 1	Table 2	Table 3
January	5710*	5750*	5630*
February	5710	5740	5620
March	5710	5740	5630
April	5720	5760	5660
May	5770	5800	5710
June	5820	5850	5780
July	5850	5880	5830
August	5870	5890	5840
September	5850	5870	5810
October	5820	5850	5760
November	5770	5810	5700
December	5730	5780	5650

* All heights in meters.

Agricultural Burn Meteorological Factors
(Sacramento Valley Air Basin)

Table 4

A.M. STABILITY °F	M.F.
≥17	0.0
15 or 16	0.1
13 or 14	0.2
11 or 12	0.3
9 or 10	0.4
7 or 8	0.5
5 or 6	0.6
3 or 4	0.7
1 or 2	0.8
0 or (-1)	0.9
≤(-2)	1.0

Table 5

P.M. STABILITY °F	M.F.
≥(-8)	0.0
-9	0.1
-10	0.2
-11	0.3
-12	0.4
-13	0.5
-14	0.6
-15	0.7
-16	0.8
-17	0.9
≤(-18)	1.0

Table 6

WIND SPEED MPH	M.F.
0 to 2	0.0
3	0.1
4	0.2
5	0.3
6	0.4
7	0.5
8	0.6
9	0.7
10	0.8
11	0.9
≥12	1.0

The basinwide meteorological factor (B.M.F.) is equal to the arithmetic mean of the meteorological factors (M.F.) from Tables 4, 5, and 6.

A.M. Stability: 3,000-foot temperature (a.m.) (°F) minus surface minimum temperature (°F).

P.M. Stability: 3,000-foot temperature (p.m.) (°F) minus adjusted surface maximum temperature* (°F).

Wind Speed: Surface to 3,000 feet average wind speed (mph).

* Maximum surface temperature minus 3°F which represents the surface temperature that will be equalled or exceeded for at least four hours.

NOTE: Authority cited: Sections 39600, 39601, 41856, and 41859, Health and Safety Code. Reference: Sections 41854, 41855, 41856, 41857, 41859, and 41863, Health and Safety Code.

State of California
AIR RESOURCES BOARD

Addendum to Resolution 83-7

May 26, 1983

Agenda Item No.: 83-6-1

As directed by the Air Resources Board at its public hearing on May 26, 1983, the following language is added to Resolution 83-7.

> BE IT FURTHER RESOLVED that the Board directs the Executive Officer to work with the air pollution control districts in the Sacramento Valley Air Basin and the agricultural community to assist the districts in securing continued funding for administration of the Sacramento Valley Air Basin agricultural burning program.

The attached resolution replaces the earlier version in which this language was omitted.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Revisions to the Agricultural Burning Guidelines and the Meteorological Criteria for Regulating Agricultural Burning Contained in Title 17, California Administrative Code, Sections 80150, 80250, and 80320

Agenda Item No.: 83-6-1

Public Hearing Date: May 26, 1983

Response Date: July 29, 1983

Issuing Authority: Executive Officer

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report also identified no adverse environmental issues.

Response: N/A

CERTIFIED: _____
James D. Boyd
Executive Officer

Date: 8/31/83

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject: Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
Resolution 83-3
Resolution 83-7
Resolution 83-8

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution 83-8

May 27, 1983

Agenda Item No.: 83-7-1

WHEREAS, Health and Safety Code Section 39601 authorizes the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Health and Safety Code Section 39801 requires the Board to administer, pursuant to Chapter 5 (commencing with Section 39800), Part 2, Division 26 of the Health and Safety Code, the air pollution control Subvention Program with such funds as may be appropriated for the purposes of said Chapter, and Health and Safety Code Sections 39800 through 39811 establish the framework and requirements of the Subvention Program;

WHEREAS, the Board has adopted regulations for administering the Subvention Program in Sections 90050 through 90500 of Title 17, California Administrative Code;

WHEREAS, Health and Safety Code Section 39806 provides that money shall be subvened under the Subvention Program to districts engaged in the reduction of air contaminants pursuant to the basinwide air pollution control plan and related implementation programs, and that any findings of the Board that a district is not so engaged in the reduction of air contaminants shall be based on criteria established by the Board jointly with districts;

WHEREAS, Section 90115 of Title 17, California Administrative Code, establishes evaluation criteria for determining whether a district is engaged in the reduction of air contaminants pursuant to the basinwide air pollution control plan and related implementation programs;

WHEREAS, Section 90115 of Title 17, California Administrative Code, further provides that following cooperation between Board and district staffs in proposing recommendations, the Board shall annually consider revisions to the evaluation criteria;

WHEREAS, the Board staff, in cooperation with district staffs and the California Air Pollution Control Officers Association, has prepared recommended evaluation criteria revisions for the 1983-84 fiscal year;

WHEREAS, Section 90110(c) of Title 17, California Administrative Code, establishes standards for granting special subventions to qualifying districts in air basins having a total population of less than 98,000;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project having significant adverse environmental impacts be adopted as originally proposed if feasible alternative or mitigation measures are available;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of the Administrative Procedure Act (Government Code, Title 2, Division 3, Part 1, Chapter 3.5); and

WHEREAS, the Board finds that:

The evaluation criteria for Fiscal Year 1983-84 set forth in Attachment A are appropriate to determine, for the purpose of subvening State funds in accordance with Section 39806 of the Health and Safety Code, whether a district is engaged in the reduction of air contaminants pursuant to the basinwide air pollution control plan and related implementation programs;

The amendment to Section 90110(c) of Title 17, California Administrative Code, set forth in Attachment B, makes explicit an appropriate formula for determining the maximum amount of special subventions for qualifying districts, and the amendment to Section 90115 set forth in Attachment C is necessary to implement the evaluation criteria in regulatory form.

The amendments set forth in Attachments A, B, and C would have no significant adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby adopts the "Evaluation Criteria for Air Pollution Control Districts Participating in the Subvention Program", for Fiscal Year 1983-84, as set forth in Attachment A hereto;

BE IT FURTHER RESOLVED THAT THE BOARD adopts the amendments to Sections 90110(c) and 90115 of Title 17, California Administrative Code, as set forth in Attachments B and C, respectively.

I certify that the above is a true and correct copy of Resolution 83-8, as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

EVALUATION CRITERIA: EMISSION INVENTORY

GOAL: To assist the State in fulfilling federal requirements for emission data and in maintaining a current, accurate, comprehensive inventory of all pollutants subject to State or federal regulation.

CRITERIA:

1. Provide updated data to the ARB on emissions from point sources in the district:

a. Provide data to fulfill federal requirements of 40 CFR 51.321 - 51.323.

b. Review all point sources in the data base and all other sources which are not area sources in the data base,[1] and update the data as necessary to reflect emissions for 1983. The updated data shall reflect emission changes which result from:

1) Reevaluation of point sources (such as source inspections, engineering evaluations, or source tests);

2) Changes in rules or permit conditions;

3) Point sources starting or ceasing operation; and

[1]The point source data base includes data for all facilities that emit more than 25 tons per year of TSP, TOG, SOx, or NOx; 250 tons per year of CO; or 5 tons per year of lead. Individual emission points within a facility are to be identified separately as point sources if they emit more than 25 tons per year of TSP, TOG, SOx, NOx; 250 tons per year of CO; or 5 tons per year of lead. Smaller emission points may be aggregated within a source category (e.g., same source classification code). Smaller sources may be included in the point source inventory data base.

4) Change in activity occurring at facilities (for example, a change from one-shift to two-shift operation or a change in energy consumption).

A district operating its own computerized data system may elect to submit updated data in computer readable form in EIS/P&R format or in any alternative format that the ARB and the district mutually agree upon.

Updated data shall be provided to the ARB by May 1, 1984,[2] or 90 days after a district receives turnaround documents from ARB, whichever is later.

2. Assist the State in updating area source emissions in the district:

a. Review all area sources which are in source categories identified as districts' responsibility in the first column of Table I, attached.

b. For area source categories identified as a district responsibility and for which estimated emissions have changed from the last previously submitted estimates by either 100 tons per year or 0.5% of the county-wide emissions for any pollutant,[3] update area

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[2]An alternative submittal date may be substituted if mutually agreed upon between a district and the ARB.

[3]Alternative criteria for determining when area source emission estimates are required may be used provided ARB reasonably determines they are adequate for fulfilling the inventory update goals. One alternative that is acceptable is to update area source emission estimates for source categories whose total emissions exceed either 100 tons per year or one percent of the county-wide emissions of that pollutant, whichever is more.

source emission estimates to reflect 1983 emissions. The update shall reflect changes which result from:

1) New controls implemented; and

2) New or better information.

c. Review all other area sources which are in source categories identified as a district's responsiblity and which have not been reviewed in the last two years, and update source emission estimates to reflect 1983 emissions.

Updated area source data and supporting documentation shall be provided to the ARB by June 1, 1984, or 90 days after a district receives turnaround documents from ARB, whichever is later.

COMMENTS:

1. These evaluation criteria will be used in audits conducted in FY 1983-84.

2. Turnaround documents for updating point source data will be available February 1, 1984.

3. The Emission Inventory Technical Advisory Committee (EITAC) will continue to coordinate district-ARB efforts to maintain a current, accurate, and comprehensive inventory.

Table I

AREA SOURCE
CATEGORY OF EMISSION SOURCE (CES) DESCRIPTIONS AND PROCESS RATE UNITS

07/12/82

RESP	CES	ACTIVITY NAME	PROCESS NAME	E AND M NAME	DIMENSION NAME	PR	UNITS
A	46425	OIL & GAS EXTRACTION	PETROLEUM & RELATED	PROCESS LOSS	PRIMARY/SECONDARY OPERATION	1000	BARRELS PRODUCED
A	46433	OIL & GAS EXTRACTION	PETROLEUM & RELATED	PROCESS LOSS	TERTIARY OPERATION	WELL-YEAR	
A	46441	OIL & GAS EXTRACTION	PETROLEUM & RELATED	PROCESS LOSS	GAS STRIPPING	MILLION	CU FT PROCESSED
D	46426	OIL & GAS EXTRACTION	LIQUID STORAGE & TRANSFER	CRUDE PETRO-EVAP		TONS	STORED
	46434	BULK PLANTS	TANKS	GASOLINE-EVAP	BREATHING LOSS	1000	GALLONS STORED
D	46442	BULK PLANTS	TANKS	GASOLINE-EVAP	WORKING LOSS	1000	GALLONS THROUGHPUT
	46426	BULK PLANTS	TANK CARS & TRUCKS	GASOLINE-EVAP	WORKING LOSS	1000	GALLONS THROUGHPUT
D	46427	GASOLINE MARKETING	LIQUID STORAGE & TRANSFER	GASOLINE-EVAP	BULK CUSTOMERS	1000	GALLONS THROUGHPUT
A	46435	SERVICE STATIONS	TANKS	GASOLINE-EVAP	WORKING LOSS	1000	GALLONS THROUGHPUT
A	46443	SERVICE STATIONS	VEHICLE REFUELING	GASOLINE-EVAP	VAPOR DISPLACEMENT	1000	GALLONS THROUGHPUT
A	46427	SERVICE STATIONS	TANKS	GASOLINE-EVAP	BREATHING LOSS	1000	GALLONS THROUGHPUT
A	46436	SERVICE STATIONS	VEHICLE REFUELING	GASOLINE-EVAP	SPILLAGE	1000	GALLONS THROUGHPUT
A	46444	PETROLEUM & GAS MARKETING	MARINE VESSELS	CRUDE PETRO-EVAP	LOADING, TANKERS	1000	GALL CAPACITY
A	46452	PETROLEUM & GAS MARKETING	MARINE VESSELS	GASOLINE-EVAP	LOADING, TANKERS	1000	GALL CAPACITY
A	46460	PETROLEUM & GAS MARKETING	MARINE VESSELS	JET FUEL-EVAP	LOADING, TANKERS	1000	GALL CAPACITY
A	46468	PETROLEUM & GAS MARKETING	MARINE VESSELS	CRUDE PETRO-EVAP	LOADING, BARGES	1000	GALL CAPACITY
A	46476	PETROLEUM & GAS MARKETING	MARINE VESSELS	GASOLINE-EVAP	LOADING, BARGES	1000	GALL CAPACITY
A	46484	PETROLEUM & GAS MARKETING	MARINE VESSELS	JET FUEL-EVAP	LIGHTERING	1000	GALL CAPACITY
A	46492	PETROLEUM & GAS MARKETING	MARINE VESSELS	CRUDE PETRO-EVAP	BALLASTING	1000	GALL CAPACITY
A	46500	PETROLEUM & GAS MARKETING	MARINE VESSELS	GASOLINE-EVAP	BALLASTING	1000	GALL CAPACITY
A	46508	SURFACE COATING - INDUSTRIAL	SURFACE COATING	COATING MATERIAL-EVAP		1000	GALLONS OF COATING
A	46516	SURFACE COATING - COMMERCIAL	SURFACE COATING	WATER BASED-EVAP	PAINTING & DECORATING	1000	GALLONS OF COATING
A	46524	SURFACE COATING - CONSUMER	SURFACE COATING	OIL BASED-EVAP	PAINTING & DECORATING	1000	GALLONS OF COATING
A	46532	SURFACE COATING - AUTO REFINISHING	SURFACE COATING	SOLVENT-EVAP	PAINTING & DECORATING	1000	GALLONS OF COATING
A	46540	SURFACE COATING - AUTO REFINISHING	SURFACE COATING	COATING MATERIAL-EVAP	AUTO DEALERS & SERVICES	1000	GALLONS OF COATING
A	46557	LAUNDRY & DRYCLEANERS	DRY CLEANING	NON SYNTHETIC-EVAP	STODDARD	GAL	PROCESSED
A	46565	LAUNDRY & DRYCLEANERS	DRY CLEANING	SYNTHETIC-EVAP		GAL	PROCESSED
A	46573	MANUFACTURING & INDUSTRIAL	DEGREASING	NON SYNTHETIC-EVAP	STODDARD	TONS	OF SOLVENT CONSUMED
A	46581	MANUFACTURING & INDUSTRIAL	DEGREASING	SYNTHETIC-EVAP		TONS	OF SOLVENT CONSUMED
A	46599	MANUFACTURING & INDUSTRIAL	DEGREASING	SOLVENT-EVAP		TONS	OF SOLVENT CONSUMED
A	46607	MANUFACTURING & INDUSTRIAL	DEGREASING	NON SYNTHETIC-EVAP		INSTALLATION	
A	46615	MANUFACTURING & INDUSTRIAL	DEGREASING	SYNTHETIC-EVAP		INSTALLATION	
A	46623	COMMERCIAL & CONSUMER	DEGREASING	EVAPORATION		1000	GALLONS OF SOLVENT CONSUME
D	46631	MANUFACTURING & INDUSTRIAL	SOLVENT USE	FREITROLEUM-EVAP	CUTBACK ASPHALT	TONS	PROCESSED
	46649	ROAD CONSTRUCTION	ASPHALT PAVING	PETROLEUM-EVAP	ROAD OIL	TONS	PROCESSED
	46657	ROAD CONSTRUCTION	ASPHALT PAVING	PETROLEUM-EVAP	PAVING ASPHALT	TONS	PROCESSED
	46665	ROAD CONSTRUCTION	ASPHALT PAVING	PETROLEUM-EVAP	EMULSIFIED ASPHALT	TONS	PROCESSED
	46673	ROAD CONSTRUCTION	SOLVENT USE	SOLVENT-EVAP		TONS	PROCESSED
A	46681	RUBBER & PLASTICS FAB	CHEMICAL PROCESSES	PROCESS LOSS	SYNTHETIC RUBBERS	TONS	PROCESSED
	46699	RUBBER & PLASTICS FAB	CHEMICAL PROCESSES	PROCESS LOSS	PLASTICS	TONS	PROCESSED
	46707	CHEMICAL & ALLIED	CHEMICAL PROCESSES	PROCESS LOSS	SODIUM CARBONATE	TONS	PROCESSED
	46715	CHEMICAL & ALLIED	CHEMICAL PROCESSES	PROCESS LOSS		TONS	PROCESSED
	46723	CHEMICAL	CHEMICAL PROCESSES	PROCESS LOSS		TONS	PROCESSED
	46731	MINERAL PRODUCTS	MINERAL PROCESSES	PROCESS LOSS		TONS	PROCESSED
	46749	MINERAL PRODUCTS	MINERAL PROCESSES	DUST	SAND/GRAVEL	TONS	PROCESSED
	46756	MINERAL & PRODUCTS MAT'LS	MINERAL PROCESSES	DUST	ASPHALT	TONS	PROCESSED
	46764	MINERAL PRODUCTS	MINERAL PROCESSES	DUST	ROCK/GRAVEL	TONS	PROCESSED
	46772	NONSPECIFIED PRODUCTS	MINERAL PROCESSES	DUST	SURFACE BLASTING	TONS	PROCESSED
	46780	MINERAL PRODUCTS	MINERAL PROCESSES	DUST	BATCHING , CONCRETE	TONS	PROCESSED
	46798	LUMBER & WOOD PRODUCTS	WOOD & PAPER PROCESSES	DUST		VARIOUS	APPLICABLE UNITS
	46806	FOOD & KINDRED	FOOD & AGRICULTURAL	PROCESS LOSS		TONS	PROCESSED
A	46814	AGRICULTURAL SERVICES	FOOD & AGRICULTURAL	EVAPORATION	FERMENTATION (WINE)	1000	GAL PRODUCED
	46822	AGRICULTURAL ACTIVITIES	INDUSTRIAL PROCESSES	PROCESS LOSS	CROP PREP FOR MARKET	1000	TONS PROCESSED
A	46830	AGRICULTURAL CROPS	PESTICIDE APPLICATION	EVAPORATION		TONS	SPRAYED
	46848	AGRICULTURAL	PESTICIDE APPLICATION	EVAPORATION	SYNTHETIC PESTICIDES	TONS	SPRAYED
A	46856	AGRICULTURAL ACTIVITIES	PESTICIDE APPLICATION	EVAPORATION	SYNTHETIC PESTICIDES	TONS	SPRAYED
A	46864	AGRICULTURAL CROPS	PESTICIDE APPLICATION	RETROLEUM-EVAP	CREOSOTE	MILES	OF RAILROAD TRACK
A	46872	AGRICULTURAL	PESTICIDE APPLICATION	EVAPORATION	NON SYNTHETIC PESTICIDES	TONS	SPRAYED
A	46880	AGRICULTURAL ACTIVITIES	PESTICIDE APPLICATION	EVAPORATION	NON SYNTHETIC PESTICIDES	TONS	SPRAYED
A	46898	AGRICULTURAL CROPS	PESTICIDE APPLICATION	EVAPORATION		TONS	SPRAYED
A	46906	COMMERCIAL	FUEL COMBUSTION	NATURAL GAS-CMBSTN		MILLION	CU FT BURNED
D	46914	MANUFACTURING & INDUSTRIAL	FUEL COMBUSTION	DISTILLATE OIL-CMBSTN		1000	GALLONS BURNED
D	46922	COMMERCIAL	FUEL COMBUSTION	NATURAL GAS-CMBSTN		MILLION	CU FT BURNED
A	46930	ACCESS & COMMERCE	FUEL COMBUSTION	RESIDUAL OIL-CMBSTN		1000	GALLONS BURNED
A	46948	GOVERNMENT	FUEL COMBUSTION	NATURAL GAS-CMBSTN		MILLION	CU FT BURNED
A	46955	RESIDENTIAL	FUEL COMBUSTION	DISTILLATE OIL-CMBSTN		1000	GALLONS BURNED
D	46963	RESIDENTIAL	FUEL COMBUSTION	LPG-CMBSTN		1000	GALLONS BURNED
D	46971	RESIDENTIAL	FUEL COMBUSTION	WOOD-CMBSTN		TONS	BURNED
A	46989	AGRICULTURAL PRODUCTION	ORCHARD HEATERS	DISTILLATE OIL-CMBSTN		INSTALLATION	
D	46997	AGRICULTURAL CROPS	AGRI DEBRIS	WASTE-CMBSTN	PRUNINGS	TONS	BURNED
A	47003	AGRICULTURAL CROPS	AGRI DEBRIS	WASTE-CMBSTN	FIELD CROPS (WASTE)	TONS	BURNED
A	47011	UNSPECIFIED ACTIVITIES	OPEN ST BURNING	SOLID MAT'L-CMBSTN	WEED ABATEMENT	TONS	BURNED
A	47029	FORESTRY	FOREST MANAGEMENT	SOLID MAT'L-CMBSTN		TONS	BURNED
A	47037	RANGE DEVELOPMENT & AGRI	RANGE IMPROVEMENT	SOLID MAT'L-CMBSTN		TONS	BURNED
D	47045	UNSPECIFIED ACTIVITIES	OPEN BURNING	WASTE-CMBSTN		TONS	BURNED
A	47052	UNSPECIFIED ACTIVITIES	WILD FIRES	SOLID MAT'L-CMBSTN	GRASS & WOODLAND	ACRES	
A	47060	UNSPECIFIED ACTIVITIES	WILD FIRES	SOLID MAT'L-CMBSTN	TIMBER & BRUSH	ACRES	
A	47078	UNSPECIFIED ACTIVITIES	STRUCTURAL FIRES	SOLID MAT'L-CMBSTN		FIRES	
A	47326	AGRICULTURAL CROPS	FARMING OPERATIONS	DUST		ACRE	PASSES
A	47340	AGRICULTURAL LIVESTOCK	FARMING OPERATIONS	DUST		HEAD	OF CATTLE CAPACITY

	A	47357	BUILDING CONSTRUCTION	CONSTRUCTION & DEMOLITION	DUST	RESIDENTIAL (2 ND ACTIVITY)	ACRES MONTH
	A	47365	BUILDING CONSTRUCTION	CONSTRUCTION & DEMOLITION	DUST	COMMERCIAL (2 ND ACTIVITY)	ACRES MONTH
	A	47373	BUILDING CONSTRUCTION	CONSTRUCTION & DEMOLITION	DUST	INDUSTRIAL (2 ND ACTIVITY)	ACRES MONTH
	A	47381	ROAD CONSTRUCTION	CONSTRUCTION & DEMOLITION	DUST		ACRES MONTH
	A	47399	ON-ROAD TRAVEL	UNPAVED ROAD	DUST	CITY & COUNTY ROADS (TRAVEL)	1000 VEHICLE MILES TRAVELED
	A	47407	ON-ROAD TRAVEL	UNPAVED ROAD	DUST	U.S. FORESTS & PARKS (TRAVEL)	1000 VEHICLE MILES TRAVELED
	A	47415	ON-ROAD TRAVEL	UNPAVED ROAD	DUST	TIMBER PRODUCTION	VMT
	A	47423	ON-ROAD TRAVEL	UNPAVED ROAD	DUST	BLM ROADS (TRAVEL)	1000 VEHICLE MILES TRAVELED
	A	47431	ON-ROAD TRAVEL	UNPAVED ROAD	DUST	FARM ROADS (TRAVEL)	1000 VEHICLE MILES TRAVELED
	A	47449	RESIDENTIAL	UTILITY EQUIPMENT	GASOLINE-CMBSTN	LAWN&GARDEN&SHOP	1000 HP-HR
	A	47456	ON-ROAD TRAVEL	PAVED ROAD	DUST		MILLION VEHICLE MILES TRAVELED
	A	47464	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	GASOLINE-CMBSTN	TRAIL BIKES.MOTORCYCLES	1000 GAL BURNED
	A	47472	CONSTRUCTION	MOBILE EQUIPMENT	COMBUSTION (E&M)		1000 HORSEPOWER-HR
	A	47480	AGRICULTURAL PRODUCTION	MOBILE EQUIPMENT	DIESEL-CMBSTN	STANDARD CROPS	1000 GALLONS BURNED
	A	47498	AGRICULTURAL PRODUCTION	MOBILE EQUIPMENT	GASOLINE-CMBSTN	STANDARD CROPS	1000 GALLONS BURNED
	A	47514	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	GASOLINE-CMBSTN	SNOW MOBILE	1000 GALLONS BURNED
	A	47522	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	GASOLINE-CMBSTN	PLEASURE CRAFT IN-BOARD	1000 GALLONS BURNED
	A	47530	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	DIESEL-CMBSTN	PLEASURE CRAFT IN-BOARD	1000 GALLONS BURNED
	A	47548	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	GASOLINE-CMBSTN	PLEASURE CRAFT OUT-BOARD	1000 GALLONS BURNED
D		47555	AIR TRANSPORTATION	AIRCRAFT	JET FUEL-CMBSTN	COMMERCIAL (AIRCRAFT)	1000 LTO'S
D		47563	AGRICULTURAL SERVICES	AIRCRAFT	GASOLINE-CMBSTN	COMMERCIAL (AIRCRAFT)	ACRES
D		47571	NATIONAL SECURITY	AIRCRAFT	JET FUEL-CMBSTN	MILITARY (AIRCRAFT)	1000 LTO'S
D		47589	AIR TRANSPORTATION	AIRCRAFT	JET FUEL-CMBSTN	CIVIL (AIRCRAFT)	1000 LTO'S
	A	47597	RAIL TRANSPORT	TRAINS	DIESEL-CMBSTN	ROAD HAULING	1000 GALLONS BURNED
	A	47605	RAIL TRANSPORT	TRAINS	DIESEL-CMBSTN	SWITCHING	1000 GALLONS BURNED
	A	47613	WATER BORNE	SHIPS	RESIDUAL OIL-CMBSTN	MANEUVERING : U.S. STEAM SHIP	1000 GALLONS BURNED
	A	47621	WATER BORNE	SHIPS	RESIDUAL OIL-CMBSTN	MANEUVERING : FOREIGN STEAM S	1000 GALLONS BURNED
	A	47639	WATER BORNE	SHIPS	DIESEL-CMBSTN	MANEUVERING : U.S. MOTOR SHIP	1000 GALLONS BURNED
	A	47647	WATER BORNE	SHIPS	DIESEL-CMBSTN	MANEUVERING : FOREIGN MOTOR S	1000 GALLONS BURNED
	A	47654	WATER BORNE	SHIPS	LIQUID MAT'L-CMBSTN	MANEUVERING : TUG BOATS	1000 GALLONS BURNED
	A	47662	WATER BORNE	SHIPS	RESIDUAL OIL-CMBSTN	BERTHING : U.S. STEAM SHIPS	1000 GALLONS BURNED
	A	47670	WATER BORNE	SHIPS	RESIDUAL OIL-CMBSTN	BERTHING : FOREIGN STEAM SHIP	1000 GALLONS BURNED
	A	47688	WATER BORNE	SHIPS	DIESEL-CMBSTN	BERTHING : U.S. MOTOR SHIPS	1000 GALLONS BURNED
	A	47696	WATER BORNE	SHIPS	DIESEL-CMBSTN	BERTHING : FOREIGN MOTOR SHIP	1000 GALLONS BURNED
	A	54353	FRUIT/VEG PRESERVATION	EQUIPMENT	DIESEL-CMBSTN	COOLING PROCESS	1000 HORSEPOWER-HR
	A	54361	FRUIT/VEG PRESERVATION	EQUIPMENT	GASOLINE-CMBSTN	COOLING PROCESS	1000 HORSEPOWER-HR
	A	54379	MISC. ACTIVITIES	MOBILE EQUIPMENT	DIESEL-CMBSTN	LIGHT DUTY . FORKLIFTS & ETC	1000 GALLONS BURNED
	A	54387	MISC. ACTIVITIES	MOBILE EQUIPMENT	GASOLINE-CMBSTN	LIGHT DUTY . FORKLIFTS & ETC	1000 GALLONS BURNED
	A	54411	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	GASOLINE-CMBSTN	FOUR-WHEEL DRIVES	1000 GALLONS BURNED
	A	54429	MISC. ACTIVITIES	MOBILE EQUIPMENT	LPG-CMBSTN	LIGHT DUTY . FORKLIFTS & ETC	1000 GALLONS BURNED
	A	54437	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	DIESEL-CMBSTN	RESIDENTIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54445	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	GASOLINE-CMBSTN	RESIDENTIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54452	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	DIESEL-CMBSTN	COMMERCIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54460	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	GASOLINE-CMBSTN	COMMERCIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54478	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	DIESEL-CMBSTN	INDUSTRIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54486	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	GASOLINE-CMBSTN	INDUSTRIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54494	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	DIESEL-CMBSTN	INSTITUTIONAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54502	BUILDING CONSTRUCTION	MOBILE EQUIPMENT	GASOLINE-CMBSTN	INSTITUTIONAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54510	ROAD CONSTRUCTION	MOBILE EQUIPMENT	DIESEL-CMBSTN		1000 GALLONS BURNED
	A	54528	ROAD CONSTRUCTION	MOBILE EQUIPMENT	GASOLINE-CMBSTN		1000 GALLONS BURNED
	A	54536	GOVERNMENT	MOBILE EQUIPMENT	DIESEL-CMBSTN	PUBLIC WORKS (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54544	GOVERNMENT	MOBILE EQUIPMENT	GASOLINE-CMBSTN	PUBLIC WORKS (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	54551	BUILDING CONSTRUCTION	CONSTRUCTION & DEMOLITION	DUST	INSTITUTIONAL (2 ND ACTIV ITY	ACRES MONTH
	A	54569	RESIDENTIAL	SPACE HEATERS	NATURAL GAS-CMBSTN		MMCF BURNED
	A	54577	RESIDENTIAL	BOILERS & HEATERS	NATURAL GAS-CMBSTN	WATER (HEATERS)	MMCF BURNED
	A	54585	RESIDENTIAL	FUEL COMBUSTION	NATURAL GAS-CMBSTN	COOKING	MMCF BURNED
	A	54593	MISC. ACTIVITIES	MOBILE EQUIPMENT	DIESEL-CMBSTN	HEAVY DUTY FORKLIFTS & ECT	1000 HOURS OPERATION
D		57281	SANITARY & WATER	SOLID WASTE LAND FILL	UNSPECIFIED E&M		ACRES
	A	57307	UNSPECIFIED ACTIVITIES	UNPLANNED FIRES	SOLID MAT'L-CMBSTN	AUTO TIRES.AUTO BODY	AUTOS BURNED
D		57315	AIR TRANSPORTATION	AIRCRAFT	GASOLINE-CMBSTN	COMMERCIAL (AIRCRAFT)	1000 LTO'S
D		57323	NATIONAL SECURITY	AIRCRAFT	GASOLINE-CMBSTN	MILITARY (AIRCRAFT)	1000 LTO'S
D		57331	AIR TRANSPORTATION	AIRCRAFT	GASOLINE-CMBSTN	CIVIL (AIRCRAFT)	1000 LTO'S
D		57349	BAKERY PRODUCTS	FOOD & AGRICULTURAL	PROCESS LOSS	ETHANOL	TONS PRODUCED
	A	58560	AGRICULTURAL PRODUCTION	MOBILE EQUIPMENT	GASOLINE-CMBSTN	SPECIALITY CROPS	1000 GALLONS BURNED
	A	58578	AGRICULTURAL PRODUCTION	MOBILE EQUIPMENT	DIESEL-CMBSTN	SPECIALITY CROPS	1000 GALLONS BURNED
	A	58602	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	DIESEL-CMBSTN	PLEASURE CRAFT IN-BOARD . PLE	1000 GALLONS BURNED
	A	58610	RECREATIONAL	OFF-ROAD MOTOR VEHICLES	GASOLINE-CMBSTN	PLEASURE CRAFT IN-BOARD . PLE	1000 GALLONS BURNED
	A	58628	WATER BORNE	OFF-ROAD MOTOR VEHICLES	DIESEL-CMBSTN	COMMERCIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	58636	WATER BORNE	OFF-ROAD MOTOR VEHICLES	GASOLINE-CMBSTN	COMMERCIAL (2 ND ACTIVITY)	1000 GALLONS BURNED
	A	58644	WATER BORNE	SHIPS	RESIDUAL OIL-CMBSTN	INTRANSIT (SHIPS) : U.S. STEA	1000 GALLONS BURNED
	A	58651	WATER BORNE	SHIPS	RESIDUAL OIL-CMBSTN	INTRANSIT (SHIPS) : FOREIGN S	1000 GALLONS BURNED
	A	58669	WATER BORNE	SHIPS	DIESEL-CMBSTN	INTRANSIT (SHIPS) : U.S. MOTO	1000 GALLONS BURNED
	A	58677	WATER BORNE	SHIPS	DIESEL-CMBSTN	INTRANSIT (SHIPS) : FOREIGN M	1000 GALLONS BURNED
D		58685	PIPE LINES	PETROLEUM & RELATED	PROCESS LOSS	NATURAL GAS	MILLION CU FT PROCESSED
	A	58693	RESIDENTIAL	SOLVENT USE	SYNTHETIC-EVAP	AEROSOL PROPELLENT	PERSONS
	A	58701	RESIDENTIAL	SOLVENT USE	NON SYNTHETIC-EVAP	AEROSOL PROPELLENT	PERSONS
D		58727	SERVICES & COMMERCE	FUEL COMBUSTION	LPG-CMBSTN		1000 GALLONS BURNED
D		58735	SERVICES & COMMERCE	SPACE HEATERS	NATURAL GAS-CMBSTN		MILLION CU FT BURNED
D		58743	SERVICES & COMMERCE	BOILERS & HEATERS	NATURAL GAS-CMBSTN	WATER (HEATERS)	MILLION CU FT BURNED
	A	60400	GOVERNMENT	CONSTRUCTION & DEMOLITION	DUST	INSTITUTIONAL (2 ND ACTIVITY)	ACRES MONTH
	A	60418	FOOD & KINDRED	FOOD & AGRICULTURAL	PROCESS LOSS	CHARCOAL BROILING	INSTALLATION
	A	60467	WINES & BRANDY	FOOD & AGRICULTURAL	EVAPORATION	AGING	BBL-YEAR OF STORED BRANDY
	A	66605	AGRICULTURAL LIVESTOCK	UNSPECIFIED PROCESSES	UNSPECIFIED E&M	WASTE	TONS PRODUCED
D		66613	TRANSPORTATION EQUIP	SURFACE COATING	COATING MATERIAL-EVAP	MARINE VESSELS	1000 GALLONS OF COATING
D		66621	LUMBER & WOOD PRODUCTS	SURFACE COATING	COATING MATERIAL-EVAP		1000 GALLONS OF COATING
D		66639	TEXTILES & APPAREL	SURFACE COATING	COATING MATERIAL-EVAP		1000 GALLONS OF COATING
D		66647	FURNITURE & FIXTURES	SURFACE COATING	COATING MATERIAL-EVAP	METAL (FURNITURES/FIXTURES)	1000 GALLONS OF COATING
D		66654	MANUFACTURING & INDUSTRIAL	SURFACE COATING	COATING MATERIAL-EVAP	CANS & CONTAINERS	1000 GALLONS OF COATING
D		66662	MANUFACTURING & INDUSTRIAL	SOLVENT USE	EVAPORATION	METAL PARTS & PRODUCTS	1000 GALLONS OF COATING
D		66670	FURNITURE & FIXTURES	SURFACE COATING	COATING MATERIAL-EVAP	WOOD (FURNITURES/FIXTURES)	1000 GALLONS OF COATING

EVALUATION CRITERIA: STATIONARY SOURCE CONTROL RULE ADOPTION

GOAL:

To adopt rules pertaining to stationary sources necessary to attain or maintain State and national ambient air quality standards.

CRITERIA:

1. Adopt rules in accordance with the schedule contained in the State Implementation Plan (SIP), or as modified by the associated reasonable further progress reports as approved by the ARB.

2. The districts shall comply with the following procedures for submittal of proposed and adopted rules:

   a. When the districts publish 30-day notices of public hearings to meet the requirements of State and federal law, the districts shall submit copies of proposed rules and hearing notices to the ARB's Regional Programs Division, SIP Section.

   b. The districts shall submit adopted rules, hearing notices, and, if required by EPA grants, evaluations of the rule impacts to the ARB's Regional Programs Division, SIP Section, for approval and submittal to EPA.

EVALUATION CRITERIA: AIR QUALITY MONITORING

GOAL:

To supplement ARB monitoring, where it exists, by carrying out those air monitoring activities which a district determines are reasonably necessary to assess the status and trend of air quality. The air monitoring data must be collected in conformance with Title 40, Part 58, Code of Federal Regulation (40 CFR Part 58), in order to be acceptable for regulatory and for State Implementation Plan (SIP) purposes.

CRITERIA:

ALL DISTRICTS:

1. Inform the ARB in writing on a quarterly basis or when a change occurs of known air quality surveillance operations conducted within the district's jurisdiction by parties other than the district or the ARB. This information shall include the name and address of the party or parties conducting such monitoring and the nature of the monitoring project.

ALL DISTRICTS OPERATING AIR MONITORING SITES:

2. Submit to the ARB monthly for all ambient air monitoring sites at which air monitoring has been conducted for a consecutive period of three months or longer, all gaseous, tape-sampled particulate (AISI), and high-volume-sampled total-suspended-particulate-matter air-monitoring data either: (1) on forms prescribed by the ARB within 21 days after the end of

the month in which the data were collected, (2) on computer magnetic tape or key punch cards with computer printout sheets within 45 days after the end of the month in a format approved by the ARB, or (3) in some other computer readable medium that the ARB and the districts mutually agree upon. "Variable" and "Method" codes and site identification codes shall conform to the ARB's latest codes. Notwithstanding the foregoing, submit to the ARB high volume data or samples for analysis of lead, sulfate, nitrate, and organic fractions within 45 days after the end of each month in which the data were collected in the format and using the codes specified above.

ALL DISTRICTS OPERATING STATE AND LOCAL AIR MONITORING STATIONS (SLAMS) AND NATIONAL AIR MONITORING STATIONS (NAMS)

3. Conduct all activities as are necessary and required to determine and report individual analyzer and sampler precision estimates, and agency precision estimates for each criteria pollutant measured under the SLAMS/NAMS network. Prepare and submit to the ARB quarterly and annual reports for data precision. Pollutants measured outside the SLAMS network are exempt from the above requirements.

4. Participate in the ARB's performance audit program at all district-operated SLAMS and NAMS.

5. Districts that operate any station designated by the ARB as a SLAMS shall have an air monitoring program plan which includes procedures and time tables for implementing federal monitoring, quality assurance, and data reporting regulations (40 CFR Part 58).

SOUTH COAST, BAY AREA, AND SAN DIEGO DISTRICTS:

6. In accordance with the timetable established in the district's monitoring plan, meet all federal requirements for a "reporting organization" as defined in 40 CFR Part 58, and submit to the ARB and the EPA quarterly and annual reports for precision and accuracy estimates for all ambient air quality data.

7. Participate in the ARB's performance audit program for selected pollutants at selected sites. Such audits shall be scheduled with the district to assure minimal disruption of the district's ongoing monitoring activities.

8. Conduct an annual review of SLAMS, NAMS, and special purpose monitoring (SPM) programs and make the necessary changes to the SLAMS monitoring program (including site upgrade or relocation) to meet the ongoing monitoring requirements of the SIP.

EVALUATION CRITERIA: NONATTAINMENT PLANNING

GOAL:

To participate in the development, adoption, and implementation of air quality plans required to achieve and maintain State and national ambient air quality standards.

CRITERIA:

ALL DISTRICTS PREPARING NONATTAINMENT PLANS:

1. Prior to plan adoption, complete those products necessary for the nonattainment plan (NAP) (e.g., emission inventory and projections, air quality analyses, air quality monitoring, stationary and area source control measures and transportation control measures.)

2. Work with the appropriate local and State agencies to institute those coordinative mechanisms [e.g., memorandums of understanding (MOUs), resolutions of commitment] necessary to implement the adopted NAP. The district shall not be held responsible for the failure of other agencies to act as may be necessary according to the NAP.

3. Annually submit (or work with the NAP lead agency to submit) the report on NAP implementation for demonstration of reasonable further progress (RFP) in accordance with EPA guidance. Areas need not develop RFP reports beyond the year of attainment of the national

EVALUATION CRITERIA: PUBLIC INVOLVEMENT/PARTICIPATION

GOAL:

To encourage and provide for public involvement/participation in developing and implementing district policies and programs.

CRITERIA:

1. Solicit active public involvement in the development of rules and regulations and in the development, adoption, and implementation of air quality management plans.

2. Establish and/or maintain a program to inform citizens of the extent and nature of the air pollution problem in the district.

Public participation programs shall be tailored to meet the needs of individual districts and unique pollution problems. At a minimum, an effective public participation program shall contain the following elements to the extent resources reasonably allow:

a. Advisory committees comprised of representatives of the public reflected by district rules or persons who provide additional technical expertise.

EVALUATION CRITERIA: STATIONARY SOURCE PERMITTING[4]

GOAL:

To help achieve and maintain State and national ambient air quality standards by having an operating permit system in place which includes a review and documentation process for permitting of stationary sources and which is detailed in the district's rules and regulations.

CRITERIA FOR EVALUATING SOURCES SUBJECT TO NEW SOURCE REVIEW AND/OR PREVENTION OF SIGNIFICANT DETERIORATION REVIEW:

In evaluating a permit to construct for non-exempt stationary sources:

1. Obtain the following information from the project applicant in order to conduct an adequate analysis:

    a. A thorough description of the proposed project, including the proposed facilities and processes, normal and maximum operating parameters, fuel use (composition and quantity), output of the facility, dates of start-up, and any planned expansions.

[4]Although these evaluation criteria do not differentiate between urban districts and non-urban districts, the criteria will be evaluated in accordance with the requirements of individual district's rules and regulations. The criteria will, therefore, differentiate between districts to the extent that the applicable regulations reflect a difference between urban and non-urban programs.

b. For sources subject to an air quality impact analysis, a description of the environmental setting of the project site before construction, including existing air quality, meteorology and topography data, location and distribution of population, and existing industrial sources in the project area.

c. An identification of all emission points or sources associated with the project and quantification of all emissions of criteria pollutants, non-criteria pollutants, and toxic air pollutants when specified or defined by the ARB.

2. Conduct an analysis of the air quality impacts of projects that are subject to air quality analysis under the permit rules of the district through use of:

a. The most applicable and recent emissions data and/or emission factors (consistent with the approved NAP when applicable);

b. The calculation procedures required by the district's permit rules;

c. The models approved for use by the ARB and EPA; and

d. The most applicable meteorological and geographical data.

In granting or denying permits to construct or operate:

1. Assure that the source, when operated, will meet all applicable federal, State, and local regulations.

2. Assure that best available control technology (BACT) or lowest achievable emission rate (LAER) will be applied in accordance with the applicable provisions of the district's permit rules.

3. Assure that, when required by the applicable provisions of the permit rules, offsets are properly applied.

4. Include conditions in the permit to assure that the proper control technology and emission limits are applied, that the source will operate in a manner consistent with the assumptions used in calculating air quality impacts, and that the source will operate in accordance with all applicable rules and regulations.

5. Provide adequate public notification of the intent to grant or deny a permit to construct or operate and conduct public hearing as required by the applicable rules and regulations.

6. Prior to issuing a permit to operate, determine compliance with conditions specified in the authority to construct by source testing or other techniques consistent with the applicable rules and regulations.

7. Maintain the following records, for the life of the subject equipment, of permit action taken by the district:

   a. The complete application for an authority to construct or operate and the district's letter to the applicant indicating that the application is complete.

   b. All analyses used to determine the required emission levels and the basis for BACT, LAER, offsets, banking, or bubbling provisions of the applicable permit rules of the district.

   c. All decisions to grant or deny an application for construction or modification.

   d. Copies of the public notification to grant or deny an application for construction, modification, or operation issued pursuant to district rules and regulations.

   e. All source test data used to determine compliance with the permits to construct or operate.

   f. Hearing board records on appeals of district decisions to grant or deny a permit.

CRITERIA FOR GENERAL PERMIT ADMINISTRATION:

1. Obtain information from the project applicant sufficient to determine if the applicant is required to obtain a permit, and information sufficient to determine if the project triggers the BACT or offset provisions of the permit rules of the district.

2. Account for emissions from each project which is granted a permit for purposes of including such emissions in the district emissions inventory and for accumulating net emissions increases from each modification to such projects.

3. Assure that the source, when operated, will meet all applicable federal, State, and local regulations, and will not cause or contribute to a violation of any State or federal ambient air quality standard.

4. Maintain records, for the life of the subject equipment, of the permit actions taken by the district, including emissions calculated for the project.

EVALUATION CRITERIA: ENFORCEMENT

GOAL:

To establish and maintain an enforcement program to ensure that all sources are complying with district rules, regulations, and permit conditions.

CRITERIA:

1. Enforce all district rules and regulations.

2. All districts shall have on their staff personnel certified to evaluate visible emissions. Evaluation of visible emissions shall be done only by certified inspectors.

3. The district shall perform thorough annual inspections and follow-up reports. An initial engineering evaluation of probable emissions and a flow diagram of the process showing all control equipment shall be drawn upon initial inspection and at the time the process is modified. All existing information shall be updated when annual inspections are performed and when the process is modified.

4. The district shall require an annual source test to determine compliance of major sources, or identify in the source file how compliance can be determined without a source test. For purposes of this criteria, a major source is considered to be one on the

Compliance Data System (CDS) list. If the district does not have its own source testing capabilities, the following options are available to it:

a. Request the ARB to source test the suspected source (source test fees outlined in Figure 1);

b. Request assistance from another district with testing capabilities;

c. Require the source to hire an independent contractor to perform the source test. This type of test shall be observed by a district staff member, or at the request of the district shall be observed by an ARB staff member; or

d. Condition the permit to operate of a major source to require annual source testing or verifiable reporting requirements which will accurately provide the compliance status of the subject source.

5. All districts, in nonattainment areas, issuing notices of violation primarily as a warning notice for a violation of a nonattainment pollutant emission standard shall develop a program for submittal of these notices for prosecution or settlement of violations.

6. The district shall submit to ARB all variance orders (i.e., emergency, interim, and regular) within 30 days of the date the order was granted.

7. The district shall investigate, to the extent resources reasonably allow, all reported breakdowns and take enforcement action against any source found not reporting a breakdown.

8. In districts that have sources with continuous emission monitors, and to the extent resources reasonably allow, inspection shall be conducted quarterly to assure that the operators of the monitors will maintain their accuracy. In addition, to the extent resources reasonably allow, monitor accuracy shall be verified for sources on the CDS list at least twice annually using parallel source testing.

9. The district shall keep a record of all complaints and action taken for four years, after which time they may be discarded.

10. The district shall develop an agricultural burning program[5] consistent with the Agricultural Burning Guidelines. The district shall document and prosecute violations in accordance with an approved agricultural burning program. The district shall keep a record of burn information available for inspections and a record of burn information within the district issued by other agencies for a minimum period of two years.

11. The districts that have Stage I vapor recovery shall inspect all bulk plants located in the districts at least annually, and terminals at least twice annually. Written documentation shall be provided for all inspections. The district shall observe a number of randomly selected bulk drops equal to at least 2.5 percent of the total number

all inspections. The district shall observe a number of randomly selected bulk drops equal to at least 2.5 percent of the total number of Stage I installations on underground storage tanks. An alternative inspection schedule may be approved if it is mutually acceptable to the districts and the ARB. Districts may follow either the alternative or the schedule specified above.

12. The districts that have Stage II vapor recovery shall inspect all service stations for which complaints of malfunction or poor maintenance were received. In addition, the district shall inspect for defects all stations at least twice annually and implement the "Out of Order" procedure as required in Section 41960.2 of the California Health and Safety Code. The list of defects is described in Section 94006, Title 17 of the California Administrative Code. The inspection shall also include checks to determine whether vapor recovery equipment operating instructions and the telephone number for registering complaints are clearly posted. An alternative inspection schedule may be approved if it is mutually acceptable to the districts and the ARB. Districts may follow either the alternative or the schedule specified above.

[5]The agricultural burning program does not require districts to perform burn day forecasting.

Figure 1

Estimated Costs to Perform Source Tests and Other Special Tests [1]

Type of Test	*Fee*
Continuous Analyzer Gaseous Emissions Test [1] with Van	$1,620.00 plus $55.00/hour
Non-continuous Emission Testing [1]	1,230.00 plus specific sample fee listed below
Particulate Matter Test	230.00/sample
Sulfur Dioxide Test	145.00/sample
Sulfuric Acid Mist (including sulfur trioxide) and Sulfur Dioxide Test	205.00/sample
Oxides of Nitrogen Test	90.00/sample
Hydrogen Sulfide Test	120.00/sample
Fluorides Test	400.00/sample
Carbon Monoxide Test	70.00/sample
Total Hydrocarbon Test	60.00/sample
Gas Chromatographic Analysis of Unknown Pollutants	110.00/sample
Vinyl Chloride Test	100.00/sample
Reid Vapor Pressure Test	45.00/test
Ambient Vinyl Chloride Test	100.00/sample
Visible Emission Evaluation Test	450.00/evaluation
Particulate Fallout Testing	75.00/sample
Floating Roof Tank Inspection	185.00/inspection
Vapor Recovery System Inspection	70.00–2,170.00/inspection
Valve and Flange Leak Test	1.75/test
Laboratory Fuel Analysis	
Carbon, Hydrogen, Nitrogen and Sulfur	30.00/sample
Ash	75.00/sample
Density	60.00/sample
Heat Content	180.00/sample
Water	75.00/sample
Asphaltenes	75.00/sample
Distillation	50.00/sample
Metals	293.00/sample
Bromine Number	50.00/sample
Lead	15.00/sample
Other Laboratory Analysis	
Water, Volatile Organic Compounds and Density (paints)	50.00/sample
Methane	40.00/sample
Total Hydrocarbon	30.00/sample
Hydrocarbons (with one to nine carbons)	55.00/sample
Molecular Weight Determination of Vapor Hydrocarbons	75.00/sample
Molecular Weight Determination of Liquid Hydrocarbons	50.00/sample
Hydrogen Sulfide	30.00/sample
Percent Water	30.00/sample
Asbestos (air filter sample)	444.00/sample
Particle Size Distribution Optical Microscopy	148.00/sample
Particle Size Distribution Electron Microscopy	296.00/sample

Notes:

1. Source test fees may also include additional cost of laboratory analysis as required.

NOTE: Authority cited: Sections 39600, 39601 and 41512, Health and Safety Code. Reference: Sections 41519, 41511 and 41512, Health and Safety Code.

EVALUATION CRITERIA FOR AIR POLLUTION CONTROL DISTRICTS PARTICIPATING IN THE SUBVENTION PROGRAM

ADOPTED: APRIL 23, 1981

BASIC AND DETAILED ELEMENTS[1]

NOTE: Evaluation criteria for emission inventory elements have two options available to the Districts. Evaluation Criterion A (1) was developed through the Emissions Inventory Technical Advisory Committee and Evaluation Criterion A (2) is similar to last year's program objectives. For FY 1981-82, Districts may choose either criteria under which to operate their emission inventory programs. Whichever criteria the District selects, the District shall operate an emissions inventory under that element for the entire year.

EVALUATION CRITERION A(1) EMISSION INVENTORY

BASIC ELEMENTS:

1. Assist the State in fulfilling federal requirements for emission data and in maintaining a current, accurate, comprehensive inventory of all pollutants subject to state or federal regulation.

2. Update the District's point source inventory[2] to reflect those significant emission changes which:

   a) Contribute to reasonable further progress (RFP) toward attainment of ambient air quality standards;
   b) Document District activities to reassess emissions from point sources (such as source inspections, engineering evaluations, or source tests);
   c) Are required by 40 CFR 51.321;
   d) Result from any point source starting or ceasing operation;
   e) Result from a change in activity occurring at a facility (for example, a change from one-shift to two-shift operation or a change in energy consumption);
   f) Result from a rule change or permit condition.

---

1 Basic Elements apply to all Districts. Detailed Elements apply to Large Urban and Small Urban Districts only unless otherwise noted.

2 The point source inventory includes data for all facilities that emit more than 25 tons per year of TSP, TOG, SOx, or NOx; 250 tons per year of CO; or 5 tons per year of lead. Individual emission points within a facility are to be identified separately if they emit more than 25 tons per year of lead. Smaller emission points may be aggregated within a source category (e.g., same source classification code.)

Updated information to represent calendar year 1981 shall be provided to ARB by May 1, 1982.

Turnaround documents for updating point source data, similar to those developed for the 1979 inventory, will be available for District use. Districts operating their own data systems may submit 1981 update data in EIS/PAR format or in any alternative format that the ARB and the District mutually agree upon.

DETAILED ELEMENT

Assist the State to update area source emission estimates to reflect emissions in 1981 for area source categories where estimated emissions changed from prior estimates by either 100 tons per year or 0.5% of the county-wide emissions for each pollutant. The changes may result from:

1) New controls implemented

2) New or better District information.

Updated data and documentation shall be provided to the ARB by June 1, 1982.

Alternative criteria may be used provided ARB agrees they are adequate for fulfilling the inventory update goals. One alternative that is acceptable is to update area source emission estimates for source categories whose emissions exceed either 100 tons per year or one percent of the county-wide emissions for each pollutant.

Turnaround documents for updating area source data will be available for District use.

SPECIAL APPLICATION:

This detailed element also applies to those rural Districts within nonattainment areas.

EVALUATION CRITERION A(2) - EMISSION INVENTORY

BASIC ELEMENTS:

1. Assist the state in fulfilling federal requirements for emission data and in maintaining a current, accurate, comprehensive inventory of all pollutants subject to state or federal regulation.

2. Review and update inventory data for all facilities within the District's jurisdiction that emit more than 25 tons per year of TSP, TOG, SOx, or NOx; 250 tons per year of CO; or 5 tons per year of lead. Individual emission sources within the facility shall be separately identified if they emit more than 25 tons per year of TSP, TOG, SOx, or NOx; 250 tons per year of CO; or 5 tons per year of lead. Smaller sources at a facility may be aggregated within a

source category (e.g., same Source Classification Code). Updated information to represent calendar year 1981 shall be provided to the ARB by May 1, 1982.

a) emissions from the facility change from the most recently submitted data by more than 5% and by more than 5 tons per year; or

b) separately identified sources have a change in status (e.g., change in compliance; begin or cease operation).

DETAILED ELEMENT:

Assist the state in the update of area source emission estimates to reflect emissions for 1981 where emissions in a category have changed by more than 5% and by more than 5 tons per year as a result of:

a) controls implemented in 1981; or

b) availability of better District information.

Updated data and documentation for District estimates should be provided to the ARB by June 1, 1982.

All data shall be provided in a format acceptable to the ARB after consultation with the District. Turn-around documents for updating point source data, similar to those developed for the 1979 inventory, will be available for District use.

SPECIAL APPLICATION:

This detailed element also applies to those rural Districts within the nonattainment areas.

EVALUATION CRITERION B - STATIONARY SOURCE CONTROLS

DETAILED ELEMENTS:

1. For rules required by the 1979 NAP, track the development of suggested control measures so that public hearings can be scheduled for the District to consider adoption of rules to implement such measures without duplicating the work done to develop the measures.

2. Within 120 days after the ARB has transmitted to the District a suggested control measure with a request that the District consider it for adoption, hold a public hearing to consider adoption of those rules which are required either to attain a National Ambient Air Quality Standard or as part of an SIP revision.

SPECIAL APPLICATION:

Detailed Element 1 also applies to the following rural Districts: El Dorado, Imperial, Kings, Los Angeles, Madera, Merced, Placer, San Bernardino, San Luis Obispo, Tulare, and Yolo-Solano.

Detailed Element 2 also applies to the following rural Districts: El Dorado, Kings, Los Angeles, Madera, Merced, Placer, San Bernardino, Tulare, and Yolo-Solano.

3. (For Districts in air basins having control councils and covered by 1 and/or 2), the District will take action as may be necessary to ensure that the Control Council has had an opportunity to consider rules covered by Detailed Elements 1 and 2 so that the Council's position can be considered at the District's public hearings.

4. During the 1981-82 fiscal year, inspect bulk plants once and terminals located in the District at least twice, and during the 1981-82 fiscal year the District will observe bulk drops equivalent to 5% of the total number (or an alternative which is acceptable to ARB) of Stage I installations on underground storage tanks once on a random selection basis.

5. During the 1981-82 fiscal year, the District will inspect all stations where complaints indicate some sort of malfunction, reinspect those stations where malfunctions or poor maintenance were detected, and other stations on a random basis. The total number of inspections shall equal at least 25% of the station population for the District.

SPECIAL APPLICATION:

Detailed Element 4 applies to the following rural Districts: Kings, Madera, Merced, Placer, San Luis Obispo, Tulare, and Yolo-Solano.

Detailed Element 5 applies to the following rural Districts: Kings, Madera, Merced, Tulare, and Yolo-Solano. It does not apply to the Small Urban Monterey Bay Unified APCD.

EVALUATION CRITERION C - AIR QUALITY MONITORING

BASIC ELEMENTS:

1. Districts that operate any station designated by the ARB as a proposed State and Local Air Monitoring Station (SLAMS) shall have an air monitoring program plan which includes procedures and time tables for implementing federal monitoring, quality assurance, and data reporting regulations (40 CFR Part 58, May 10, 1979).

2. Submit to the ARB monthly for all air monitoring sites at which air monitoring has been conducted for a consecutive period of three months or longer, all gaseous, tape sampled particulate (AISI), and high volume sampled total suspended particulate matter air monitoring data either: (1) on forms prescribed by the ARB within 21 days after the end of the month in which the data were collected, or (2) on computer magnetic tape or key punch cards with computer printout sheets within 45 days after the end of the month in a format approved by the ARB. "Variable" and "Method" codes, and site identification codes shall conform to the ARB's latest codes. Notwithstanding the foregoing, submit to the ARB data for lead, sulfate, and nitrate, and for organic analyses of high volume filters within 45 days after the end of each month in which the data were collected, in the format and using the codes specified above.

3. Documentation of Nondistrict Monitoring

   Advise the ARB in writing on a quarterly basis of known air quality surveillance operations conducted within the District's jurisdiction by parties other than the District or the ARB. This information should include the name and address of the party or parties conducting such monitoring and the nature of the monitoring project.

DETAILED ELEMENTS: SPECIAL APPLICATION:

Detailed elements 1, 2, and 3 apply to the large urban Districts only.

1. In accordance with the timetable established in the District's monitoring plan, meet all federal requirements for a "reporting organization" as defined in 40 CFR Part 58, and submit to the ARB and the EPA quarterly and annual reports for precision and accuracy estimates for all ambient air quality data.

2. Participate in the ARB's performance audit program for selected pollutants at selected sites. Such audits shall be scheduled with District concurrence to assure minimal disruption of the District's ongoing monitoring activities.

3. Conduct an annual review of SLAMS, National Air Monitoring Station (NAMS), and Special Purpose Monitoring (SPM) monitoring programs and, with ARB concurrence, make the necessary changes to the SLAMS monitoring program (including site upgrade or relocation) to meet the ongoing monitoring requirements of the SIP.

SPECIAL APPLICATION:

Detailed elements 4 and 5 apply only to those small urban and rural Districts that operate air monitoring analyzers and samplers.

4. Conduct all activities, including collocated high-volume sampling, bi-weekly precision tests, as are necessary and required to determine and report individual analyzer and sampler precision estimates, and agency precision estimates for each criteria pollutant measured under the SLAMS/NAMS network. Prepare and submit to the ARB quarterly and annual reports for data precision.

5. Participate in the ARB's performance audit program at all District-operated SLAMS and NAMS.

EVALUATION CRITERION D - ATTAINMENT PLANNING

BASIC ELEMENTS:

Participate in the development, adoption, and implementation of air quality plans required to achieve and maintain state and federal ambient air quality standards.

DETAILED ELEMENTS:

1. Complete those technical work products necessary for an approvable 1982 NAP (i.e., emission inventory and projections, air quality analyses, air quality monitoring, stationary and area source control measures).

2. Work with the appropriate local and state agencies to develop those coordinative mechanisms (e.g., MOUs, resolutions) necessary to insure the development, adoption, and implementation of an approvable 1982 NAP.

3. Submit (or work with the NAP lead agency to submit) to ARB by July 1, 1982 the second annual report on NAP implementation of maintenance of Reasonable Further Progress.

EVALUATION CRITERION E - PREVENTION OF SIGNIFICANT DETERIORATION

BASIC ELEMENT:

Consider adoption of the New Source Review/Prevention of Significant Deterioration (NSR/PSD) rule being jointly developed by ARB and CAPCOA as a Suggested Control Measure.

EVALUATION CRITERION F - California Environmental Quality Act (CEQA) REVIEWS

BASIC ELEMENT:

Review and comment upon the air quality impacts of proposed major private and public projects in accordance with the (CEQA) to the extent resources are available to the District.

DETAILED ELEMENTS:

In cooperation with ARB staff:

1. Continue to investigate simplication of the process for preparing air quality impact analysis in CEQA statements;

2. Review for and urge consistency between proposed project and adopted NAP; and

3. Recommend and urge emissions and air quality mitigation when needed.

EVALUATION CRITERION G - PUBLIC INVOLVEMENT/PARTICIPATION

BASIC ELEMENT:

Encourage and provide for public involvement/participation in developing and implementing District policies and programs.

DETAILED ELEMENTS:

1. Solicit active public involvement in the development of rules and regulations and in the development, adoption, and implementation of the NAP.

2. Establish and/or maintain a program to inform citizens of the extent and nature of the air pollution problem in the District.

ATTACHMENT B

PROPOSED

Amendment to Title 17, California Administrative Code,
Section 90110(c)

Amend Section 90110(c) to read as follows:

(c) "Special subvention" means a subvention authorized by Section 39804 of the Health and Safety Code. Such a subvention may be granted to a district participating in a coordinated basinwide program as described in subsection (a) of this section and lying in an air basin whose population is less than 98,000. If the funding limit specified in Section 39804 of the Health and Safety Code is increased pursuant to Section 39805 of the Health and Safety Code, the ~~required-per-capita-matching-funds-shall-reflect-any increase-pursuant-to-Section-39805-in-the-maximum-per-capita-subvention-rate for-coordinated-subventions.~~ per capita funds budgeted by each district necessary to qualify for a special subvention shall be increased by the same proportion. The sum of the special subventions for which the districts in an air basin shall be eligible shall not exceed the amount equal to the difference between (1) the current maximum special subvention funding limit, established by Section 39804 of the Health and Safety Code or pursuant to Section 39805 of the Health and Safety Code, and (2) the current special subvention per capita rate, established by Section 39804 of the Health and Safety Code or pursuant to this subsection, multiplied by the basin population. The sum of the special subventions ~~to-be-granted-to-the-districts~~ in an air basin shall be prorated according to population among the districts in the air basin.

NOTE: Authority cited: Sections 39600, 39601, and 39801, Health and Safety Code. Reference: Sections 39515, 39801-39804, and 39810, Health and Safety Code.

ATTACHMENT C

PROPOSED

Amendment to Title 17, California Administrative Code,
Section 90115

Amend Section 90115 to read as follows:

90115. Evaluation Criteria. The ARB staff shall develop in cooperation with the districts and the Board shall adopt evaluation criteria for each category established in Section 90120 which are appropriate to determine, in accordance with Section 39806 of the Health and Safety Code, whether districts are engaged in the reduction of air contaminants pursuant to the basinwide air pollution control plan and related implementation programs. Following cooperation between ARB and district staff in proposing recommendations, the Board shall hold a public hearing annually in the first quarter of the calendar year to consider revisions to the evaluation criteria. The evaluation criteria are set forth in the Air Resources Board's "Evaluation Criteria for Air Pollution Control Districts Participating in the Subvention Program", adopted on April 23, 1981, and amended _____.

NOTE: Authority cited: Sections 39600, 39601, and 39801, Health and Safety Code. Reference: Sections 39801, and 39806, Health and Safety Code.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Adoption of FY 1982-83 Subvention Criteria and Amendments to Subvention Regulations, Title 17, California Administrative Code, Sections 90110(c) and 90115

Agenda Item No.: 83-7-1

Public Hearing Date: May 27, 1983

Response Date: May 27, 1983

Issuing Authority: Air Resources Board

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no adverse environmental effects.

Response: N/A

CERTIFIED: Harold Holmes
Board Secretary

Date: 08/05/83

RECEIVED BY
Office of the Secretary

DEC 0 6 198.

Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject: Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
Resolution 83-3
Resolution 83-7
Resolution 83-8

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution 83-9
May 26, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, a solicited research Proposal Number 1197-99 entitled "Assessment of Heavy Duty Gasoline and Diesel Trucks in California: Population and Use Patterns", has been submitted by the Pacific Environmental Services, Inc. to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1197-99 entitled "Assessment of Heavy-Duty Gasoline and Diesel Trucks in California: Population and Use Patterns", submitted by the Pacific Environmental Services, Inc. for a total amount not to exceed $149,782; and

WHEREAS, the Governor's Executive Order D-1-83 prohibits State agencies from awarding research contracts during FY 1982-83;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1197-99 entitled "Assessment of Heavy-Duty Gasoline and Diesel Trucks in California: Population and Use Patterns", submitted by the Pacific Environmental Services, Inc. for a total amount not to exceed $149,782; and

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-1-83 on awarding new contracts be granted, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $149,782

I certify that the above is a true and correct copy of Resolution 83-9 as passed by the Air Resources Board.

Harold Holmes, Secretary

ITEM NO.: 83-6-3b(1)
DATE: May 26, 1983

ITEM: Research Proposal No. 1197-99 entitled "Assessment of Heavy-Duty Gasoline and Diesel Trucks in California: Population and Use Patterns"

RECOMMENDATION: Adopt Resolution 83-9 approving Proposal No. 1197-99 for funding in an amount not to exceed $149,782.

SUMMARY: As emissions from light-duty vehicles (LDVs) come under more stringent control, heavy-duty vehicles (HDVs) will account for an increasing fraction of mobile source emissions. According to ARB staff estimates, the contribution of heavy-duty vehicles to on-road mobile source NOx emissions will increase from about 20 percent of the total in 1976 to about 40 percent in 1987. Over the same time period, their contribution to mobile source particulate emissions is expected to increase from about 14 to 30 percent.

Methods currently used for estimating HDV mileage by county involve simplifying assumptions which cause unknown but potentially significant errors in the county-wide HDV emission inventories. Due to the increasing importance of heavy-duty vehicles as an emission source, it is necessary to obtain a more accurate distribution of HDV mileage in the state. The objectives of this study are to: 1) obtain estimates of heavy-duty vehicle miles traveled (VMT) by county, vehicle type, age, weight class and motive power (gasoline and diesel); 2) develop a method for projecting future VMT; and 3) determine seasonal, weekly and diurnal variation in HDV traffic, average number of daily trips, average fuel consumption and average ratio of vehicle weight to engine displacement.

The recommended contractor, Pacific Environmental Services (PES), will review the California Department of Transportation computer model for heavy-duty vehicle VMT (Caltrans HDV model) for completeness of HDV traffic count data. Based on findings of this investigation and the spatial distribution of highways and streets, PES would design and implement a supplementary traffic count survey at 30 locations representing several highway types (e.g., urban freeway, urban non-freeway, rural highway, etc.) in order to obtain a breakdown of traffic counts by vehicle types for various highway types. Using this and other information, PES would devise an allocation scheme for countywide VMT for each vehicle type, based upon the fractional contribution of each highway type to county total highway miles and to all-traffic VMT. Second, PES would conduct a telephone survey of 1500 California

registered HDV owners, in collaboration with Eve Fielder of the Institute of Social Survey Research, UCLA. In addition, field interviews of drivers of HDVs at selected weigh stations would be conducted to gather information on travel within California by HDVs base-plated in other states. Future VMT would be projected using the California Energy Commission Freight Model.

The study will be conducted in two phases. The contractor will first review available relevant data, identify data needs, develop an approach for estimating HDV use factors and a plan for collection of necessary data. Collection and reduction of data in the second phase will be contingent upon approval by the Research Screening Committee of the approach developed in the first phase.

A Request for Proposals for this study was issued in November, 1982, and six proposals were received by December 17, 1982. Proposals were reviewed by the staff and by the Research Screening Committee at its meeting on May 12, 1983. The Committee selected the proposal submitted by Pacific Environmental Services, Inc. for recommendation to the Board.

State of California
AIR RESOURCES BOARD

Resolution 83-10
May 26, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1191-98 (A) entitled "A Test Site for the Engineering Evaluation of Toxic Airborne Effluents" has been submitted by the Regents of the University of California, Davis to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1191-98 (A) entitled "A Test Site for the Engineering Evaluation of Toxic Airborne Effluents", submitted by the Regents of the University of California, Davis for a total amount not to exceed $99,078; and

WHEREAS, the Governor's Executive Order D-1-83 prohibits State agencies from awarding research contracts during FY 1982-83;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1191-98 (A) entitled "A Test Site for the Engineering Evaluation of Toxic Airborne Effluents", submitted by the Regents of the University of California, Davis for a total amount not to exceed $99,078;

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-1-83 on awarding new contracts be granted, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $99,078.

I certify that the above is a true and correct copy of Resolution 83-10 as passed by the Air Resources Board.

Harold Holmes, Secretary

State of California
AIR RESOURCES BOARD

Item No.: 83-6-3b(2)
Date: May 26, 1983

ITEM: Research Proposal No. 1191-98 (A) entitled "A Test Site for the Engineering Evaluation of Toxic Airborne Effluents"

RECOMMENDATION: Adopt Resolution 83-10 approving Research Proposal No. 1191-98 (A) for funding in an amount not to exceed $99,078.

SUMMARY: The University of California, Davis proposes to make available to ARB staff an engineering facility and the technical expertise of the College of Engineering faculty and graduate students to evaluate control methods and to develop measurement methods for toxic air pollutants. The development of control and measurement methods for airborne toxic pollutants is a new area of activity and the Air Resources Board lacks the engineering test facilities and the required technical expertise to carry out several specific test programs that have been identified as critical to the Board's toxics program.

The facility will be on campus. ARB staff will have access to technical input from the various on-campus technical and engineering schools, including Epidemiology, Atmospheric Sciences, Toxicology, Medicine and Engineering.

The University will make available much of the analytical equipment needed to carry out the proposed projects, and the UC will provide access to mini-computers at no-cost to the Board.

Current proposed projects include:

1. geothermal condensate--hydrogen sulfide measurement method development;

2. ethylene oxide--pilot scale scrubber test;

3. volatile organic compounds--emission prediction and test method development; and

4. toxic waste incineration--pilot scale feasibility study.

The Research Screening Committee has approved the unsolicited proposal.

State of California
AIR RESOURCES BOARD

Resolution 83-12
June 29, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1213-99 entitled "The Effects of Present and Potential Air Pollution on Important San Joaquin Valley Crops" has been submitted by the Regents of the University of California, Riverside to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1213-99 entitled "The Effects of Present and Potential Air Pollution on Important San Joaquin Valley Crops", submitted by the Regents of the University of California, Riverside for a total amount not to exceed $124,894;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1213-99 entitled "The Effects of Present and Potential Air Pollution on Important San Joaquin Valley Crops", submitted by the Regents of the University of California, Riverside for a total amount not to exceed $124,894; and

BE IT FURTHER RESOLVED, that the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $124,894.

I certify that the above is a true and correct copy of Resolution 83-12 as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-8-4b(2)
DATE: June 29, 1983

ITEM: Research Proposal No. 1213-99 entitled "The Effects of Present and Potential Air Pollution on Important San Joaquin Valley Crops".

RECOMMENDATION: Adopt Resolution 83-12 approving Research Proposal No. 1213-99 for funding in an amount not to exceed $124,894.

SUMMARY: Very little is known about the effects of SO_2, alone or in combination with ambient oxidants, on important San Joaquin Valley crops. This type of information is needed for evaluating the effects of current and possible future air quality in the Valley upon vegetation. The proposed study would determine the effects of SO_2 and/or ambient oxidants on cotton and grapes.

The dominant cotton variety in the San Joaquin Valley, SJ-2, is expected to be supplanted by the variety C-1 in the near future. In these experiments, the two varieties will be grown in open-top field fumigation chambers and exposed to the various air pollution treatments. The treatments include: 1) pollution-free air, 2) ambient air, 3) filtered air and .05 ppm SO_2, 4) filtered air and .1 ppm SO_2, 5) ambient air and .05 ppm SO_2, 6) ambient air and .1 ppm SO_2, and 7) ambient air (no chamber). The plants will be observed for visible symptoms, plant growth, flower production, boll set, cotton yield and lint quality.

Approximately 40 percent of the grape acreage in California is devoted to Thompson Seedless grapes. Prior work by the proponent demonstrated that ambient oxidants in the San Joaquin Valley reduced the average yield of Thompson Seedless grapes by 20 percent. This study will expose Thompson Seedless grapes to 1) ambient unfiltered air, 2) carbon-filtered air, 3) ambient air and .1 ppm SO_2, 4) filtered air and .1 ppm SO_2, and 5) ambient air (no chamber). The vines are already established and will be covered with rectangular open-top fumigation chambers. Data will be recorded on vegetative growth, number and weight of bunches and acid and sugar content. This proposal is the first year of an expected three-year study. Previous experience by the proponent showed that grape vines need to be exposed to the air pollution treatments for a minimum of three years before air pollution effects can be detected. Proposals for subsequent years will be submitted when appropriate.

State of California
AIR RESOURCES BOARD

Resolution 83-14

June 29, 1983

Agenda Item No.: 83-8-1

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board ("Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Section 39607(d) of the Health and Safety Code requires the Board to adopt test procedures to measure compliance with its nonvehicular emission standards and those of the air pollution control and management districts;

WHEREAS, the Board's staff has developed sixteen test methods for determining compliance with district nonvehicular (stationary source) emission standards;

WHEREAS, the test methods have been thoroughly field tested by the Board's staff;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project having significant adverse environmental impacts be adopted as proposed if feasible alternatives or mitigation measures are available which would substantially reduce such adverse impacts;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of the Administrative Procedure Act (Government Code, Title 2, Division 3, Part 1, Chapter 3.5); and

WHEREAS, the Board finds that:

Adoption of the sixteen test methods set forth in Attachment A, and adoption of regulations incorporating the test methods, set forth in Attachment B, is necessary and appropriate to satisfy the requirements of Section 39607(d) of the Health and Safety Code and may simplify the identification, adoption and enforcement of nonvehicular emission standards;

Adoption of Section 94100, Title 17, California Administrative Code, set forth in Attachment B, is necessary to assure that a specified test method is applicable to all situations covered by one of the sixteen test methods, while providing the districts the flexibility of using their own methods if they wish; and

The adoption of the test methods and regulations set forth in Attachments A and B will have no significant adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby adopts the sixteen test methods for determining compliance with district nonvehicular (stationary source) emission standards set forth in Attachment A.

BE IT FURTHER RESOLVED that the Board hereby adopts Sections 94100 through 94116, Title 17, California Administrative Code, as set forth in Attachment B hereto.

I certify that the above is a true and correct copy of Resolution 83-14 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

METHOD 1 - SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle: To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

1.2 Applicability: This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4). (2) a stack is smaller than about 0.30 meter (12 in.) in diameter or 0.071 m^2 (113 $in.^2$) in cross-sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

The requirements of this method must be considered before construction of a new facility from which emissions will be measured; failure to do so may require subsequent alterations to the stack or deviation from the standard procedure. Cases

involving variants are subject to approval by the Control Agency's authorized representative.

2. Procedure

2.1 Selection of Measurement Site. Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance. For a rectangular cross section, an equivalent diameter (D_e) shall be calculated from the following equation, to determine the upstream and downstream distances: $D_e = \frac{2LW}{L + W}$ where L = length and W = width.

2.2 Determining the Number of Traverse Points

2.2.1 Particulate Traverses. When the eight-and two-diameter criterion can be met, the minimum number of traverse points shall be: (1) twelve, for circular or rectangular stacks with diameters (or equivalent diameters) greater than 0.61 meter (24 in.); (2) eight, for circular stacks with diameters between 0.30 and 0.61 meter (12-24 in.); (3) nine, for rectangular stacks with equivalent diameters between 0.30 and 0.61 meter (12-24 in.).

involving variants are subject to approval by the Control Agency's authorized representative.

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When the eight-and two-diameter criterion cannot be met, the minimum number of traverse points is determined from Figure 1-1. Before referring to the Figure, however, determine the distances from the chosen measurement site to the nearest upstream and downstream disturbances, and divide each distance by the stack diameter or equivalent diameter, to determine the distance in terms of the number of duct diameters. Then, determine from Figure 1-1 the minimum number of traverse points that corresponds: (1) to the number of duct diameters upstream; and (2) to the number of diameters downstream. Select the higher of the two minimum numbers of traverse points, or a greater value, so that for circular stacks the number is a multiple of 4, and for rectangular stacks, the number is one of those shown in Table 1-1.

Subject to the approval of the Control Agency's authorized representative, the minimum number of traverse points may be less than that determined from Figure 1-1 to accommodate specific test situations.

TABLE 1-1. Cross-sectional Layout for Rectangular Stacks

Number of Traverse Points	Matrix layout
9	3 x 3
12	4 x 3
16	4 x 4
20	5 x 4
25	5 x 5
30	6 x 5
36	6 x 6
42	7 x 6
49	7 x 7

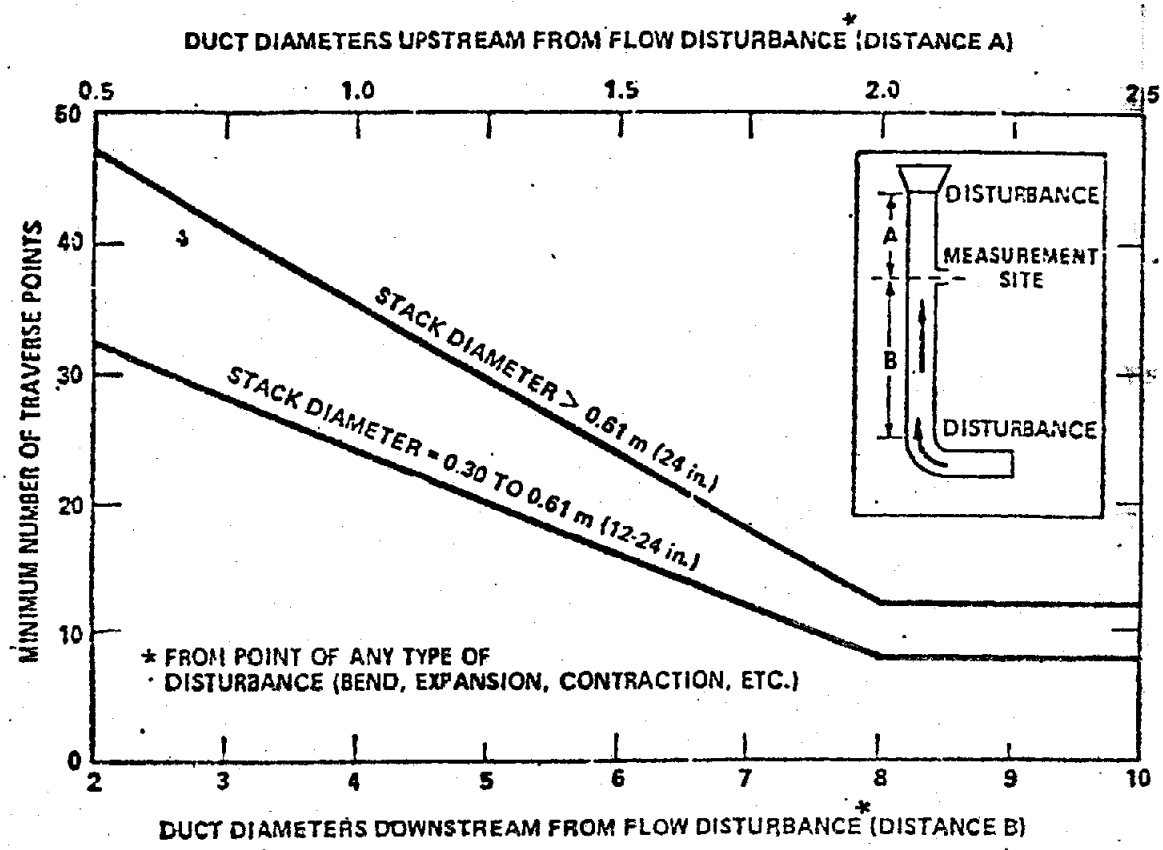

Figure 1-1. Minimum number of traverse points for particulate traverses.

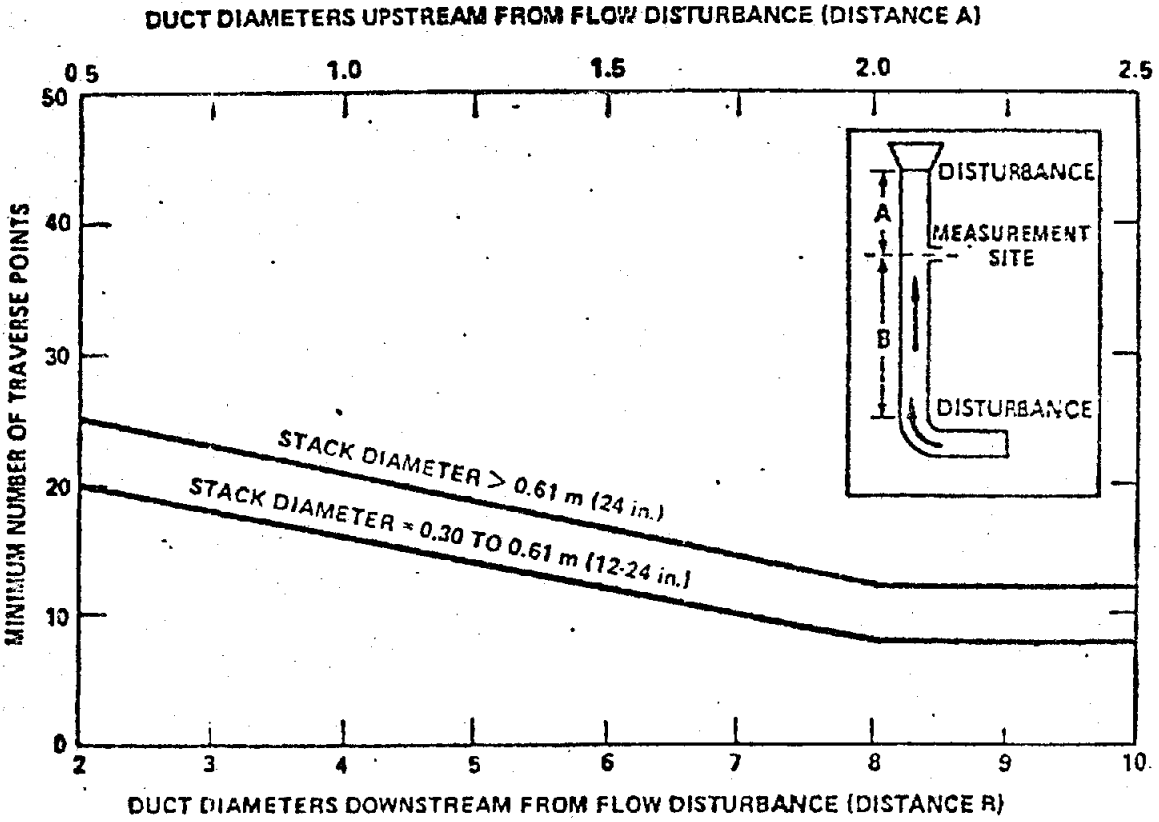

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

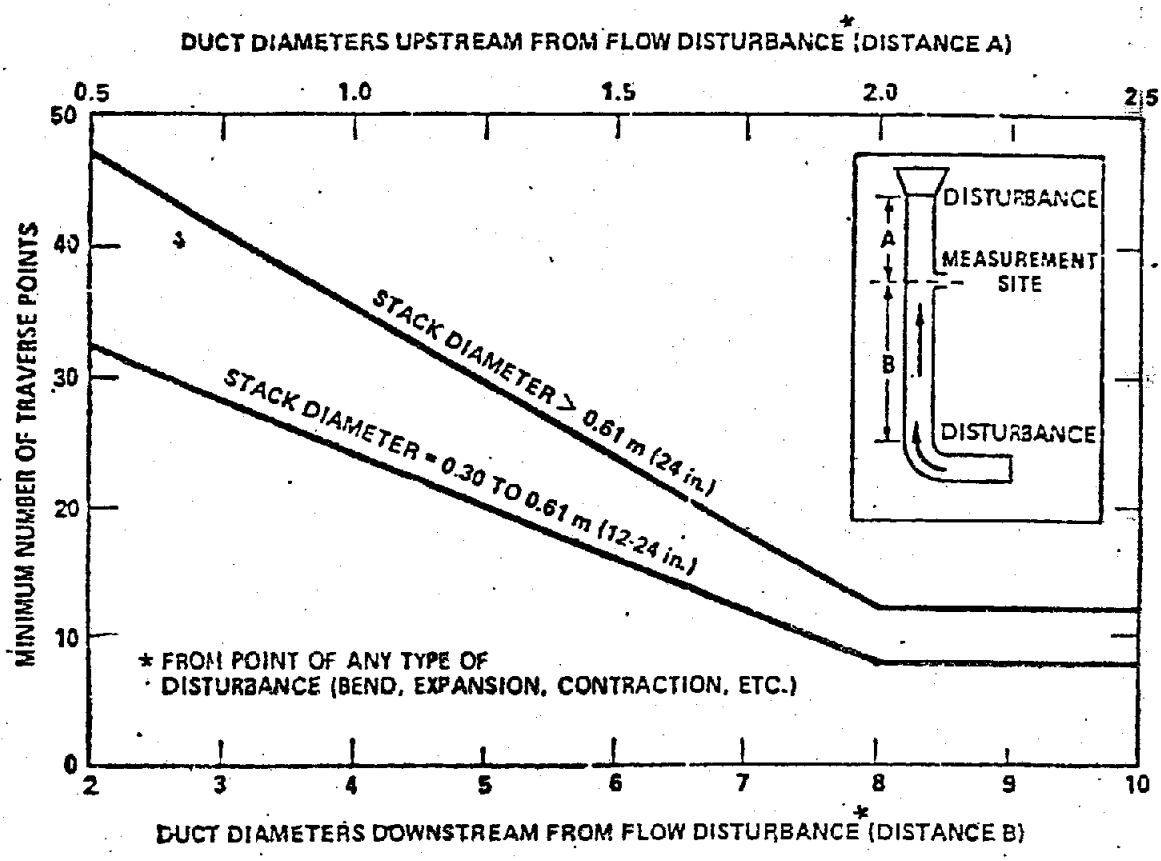

Figure 1-1. Minimum number of traverse points for particulate traverses.

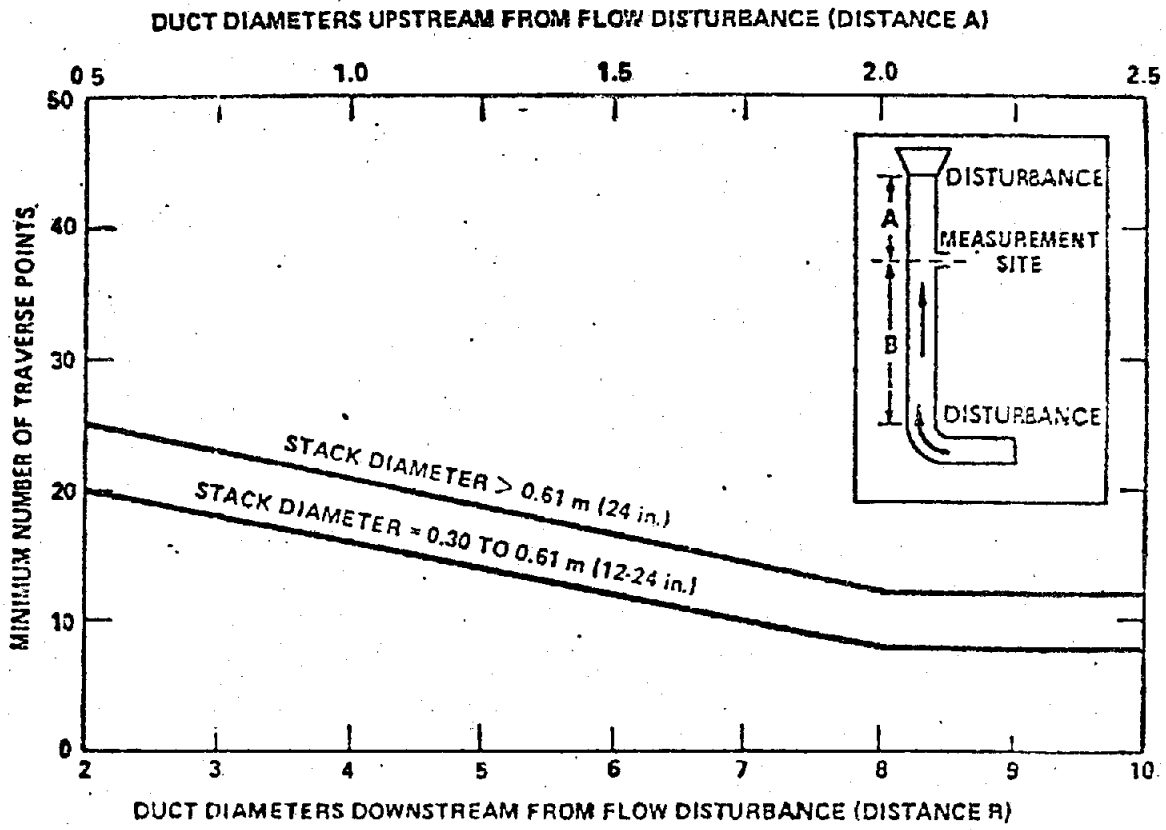

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

2.2.2 Velocity (Non-Particulate) Traverses. When velocity or volumetric flow rate is to be determined (but not particulate matter), the same procedure as that for particulate traverses (Section 2.2.1) is followed, except that Figure 1-2 may be used instead of Figure 1-1.

Subject to the approval of the Control Agency's authorized representative, the minimum number of traverse points may be less than that determined from Figure 1-2 to accommodate specific test situations.

2.3 Cross-Sectional Layout and Location of Traverse Points

2.3.1 Circular Stacks. Locate the traverse points on two perpendicular diameters according to Table 1-2 and the example shown in Figure 1-3. Any equation that gives the same values as those in Table 1-2 may be used in lieu of Table 1-2. For particulate traverses, one of the diameters must be in a plane containing the greatest expected concentration variation, e.g., after bends, one diameter shall be in the plane of the bend. This requirement becomes less critical as the distance from the disturbance increases; therefore, other diameter locations may be used, subject to approval of the Control Agency's authorized representative.

Table 1-2. Location of traverse points in circular stacks
(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8				96.7	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.9	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

TRAVERSE POINT	DISTANCE, % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

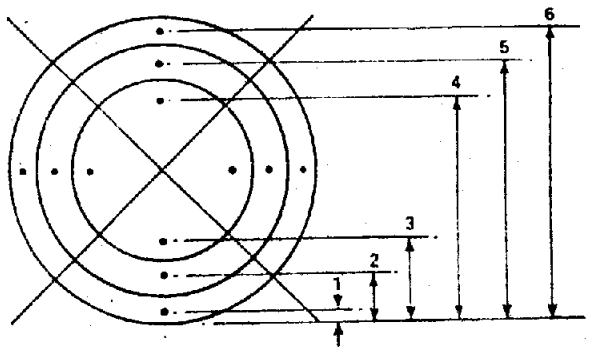

Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

Table 1-2. Location of traverse points in circular stacks
(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8				96.7	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.9	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

TRAVERSE POINT	DISTANCE, % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

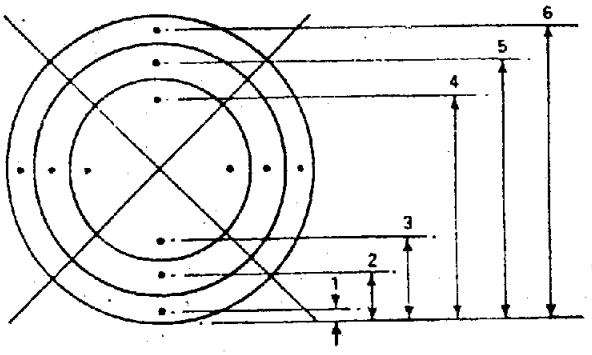

Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

In addition, for stacks having diameters greater than 0.61 m (24 in.), no traverse points shall be located within 2.5 centimeters (1.00 in.) of the stack walls; and for stack diameters equal to or less than 0.61 m (24 in.) no traverse points shall be located within 1.3 cm (0.50 in.) of the stack walls. To meet these criteria, observe the procedures given below.

2.3.1.1 Stacks with Diameters Greater Than 0.61 m (24 in.). When any of the traverse points as located in Section 2.3.1 fall within 2.5 cm (1.00 in.) of the stack walls, relocate them away from the stack walls to: (1) a distance of 2.5 cm (1.00 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger. These relocated traverse points (on each end of a diameter) shall be the "adjusted" traverse points.

Whenever two successive transverse points are combined to form a single adjusted traverse point, treat the adjusted point as two separate traverse points, both in the sampling (or velocity measurement) procedure, and in recording the data.

2.3.1.2 Stacks with Diameters Equal to or Less Than 0.61 m (24 in.). Follow the procedure in Section 2.3.1, noting only that any "adjusted" points should be relocated away from the stack walls to: (1) a distance of 1.3 cm (0.50 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger.

2.3.2 Rectangular Stacks. Determine the number of traverse points as explained in Sections 2.1 and 2.2 of this method. From Table 1-1, determine the grid configuration. Divide the stack cross-section into as many equal rectangular elemental areas as traverse points, and then locate a traverse point at the centroid of each equal area according to the example in Figure 1-4.

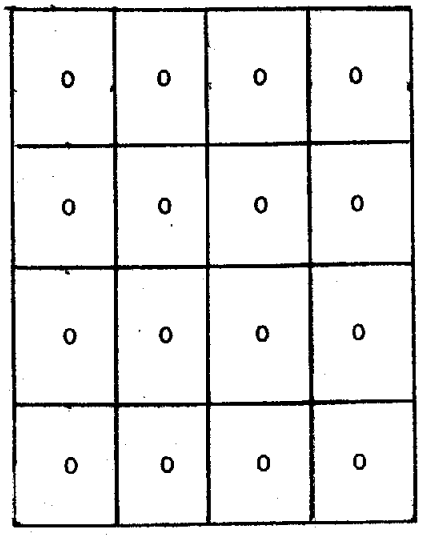

Figure 1-4
Example Showing Rectangular Stack Cross Section Divided into Twelve Equal Areas, with a Traverse Point at Centroid of Each Area

2.3.1.2 Stacks with Diameters Equal to or Less Than 0.61 m (24 in.). Follow the procedure in Section 2.3.1, noting only that any "adjusted" points should be relocated away from the stack walls to: (1) a distance of 1.3 cm (0.50 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger.

2.3.2 Rectangular Stacks. Determine the number of traverse points as explained in Sections 2.1 and 2.2 of this method. From Table 1-1, determine the grid configuration. Divide the stack cross-section into as many equal rectangular elemental areas as traverse points, and then locate a traverse point at the centroid of each equal area according to the example in Figure 1-4.

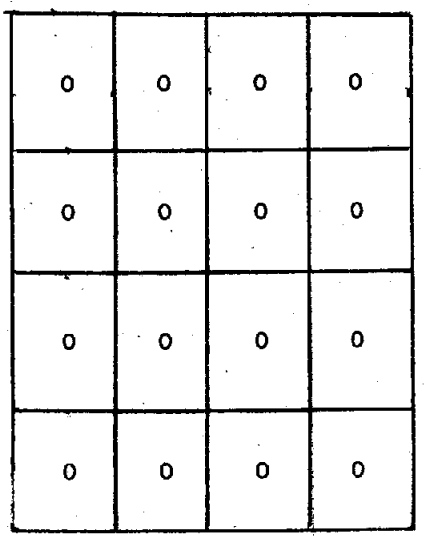

Figure 1-4
Example Showing Rectangular Stack Cross Section Divided into Twelve Equal Areas, with a Traverse Point at Centroid of Each Area

If the tester desires to use more than the minimum number of traverse points, expand the "minimum number of traverse points" matrix (see Table 1-1) by adding the extra traverse points along one or the other or both legs of the matrix; the final matrix need not be balanced. For example, if a 4 x 3 "minimum number of points" matrix were expanded to 36 points, the final matrix could be 9 x 4 or 12 x 3, and would not necessarily have to be 6 x 6. After constructing the final matrix, divide the stack cross-section into as many equal rectangular, elemental areas as traverse points, and locate a traverse point at the centroid of each equal area.

Subject to the approval of the Control Agency's authorized representative, alternatives to the matrix layout prescribed in Table 1-1 may be used to accommodate specific test situations.

The situation of traverse points being too close to the stack walls is not expected to arise with rectangular stacks. If this problem should ever arise, the Control Agency's authorized representative must be contacted for resolution of the matter.

2.4 Verification of Absence of Cyclonic Flow. In most stationary sources, the direction of stack gas flow is essentially parallel to the stack walls. However, cyclonic flow may exist (1) after such devices as cyclones and inertial demisters following venturi

scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined. The following techniques are acceptable for this determination.

Level and zero the manometer. Connect a Type S pitot tube to the manometer. Position the Type S pitot tube at each traverse point, in succession, so that the planes of the face openings of the pitot tube are perpendicular to the stack cross-sectional plane: when the Type S pitot tube is in this position it is at "0 reference." Note the differential pressure (% p) reading at each traverse point. If a null (zero) pitot reading is obtained at 0° reference at a given traverse point, an acceptable flow condition exists at that point. If the pitot reading is not zero at 0° reference, rotate the pitot tube (up to ± 90° yaw angle), until a null reading is obtained. Carefully determine and record the value of the rotation angle (a) to the nearest degree. After the null technique has been applied at each traverse point, calculate the average of the absolute values of a; assign a value of 0° to those points for which no rotation was required, and include these in the overall average. If the average value of a is greater than 10° the overall flow condition in the stack is unacceptable and alternative methodology, subject to the approval of the Control Agency's authorized representative must be used to perform accurate sample and velocity traverses.

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3. Bibliography

1. Determining Dust Concentration in a Gas Stream. ASME. Performance Test Code No. 27. New York, 1957.

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4. Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM Standards, Part 23. ASTM Designation D-2928-71. Philadelphia, PA. 1971.

5. Hanson, H.A., et al. Particulate Sampling Strategies for Large Power Plants Including Nonuniform Flow. USEPA, ORD, ESRL, Research Triangle Park, NC. EPA-600/2-76-170. June 1976.

6. Entropy Environmentalists, Inc. Determination of the Optimum Number of Sampling Points: An Analysis of Method 1 Criteria. Environmental Protection Agency. Research Triangle Park, NC. EPA Contract No. 68-01-3172, Task 7.

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE (TYPE S PITOT TUBE)

1. Principle and Applicability

1.1 Principle: The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

1.2 Applicability: This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow.

This procedure is not applicable at measurement sites which fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions. When unacceptable conditions exist, alternative procedures, subject to the approval of the Control Agency's Authorized Representative, must be employed to make accurate flow rate determinations; examples of such alternative procedures are: (1) to install straightening vanes; (2) to calculate the total volumetric flow rate stoichiometrically, or (3) to move to another measurement site at which the flow is acceptable.

2. Apparatus

Specifications for the apparatus are given below. Any other apparatus that has been demonstrated (subject to approval of the Control Agency's Authorized Representative) to be capable of meeting the specifications will be considered acceptable.

2.1 Type S Pitot Tube. The Type S pitot tube (Figure 2-1) shall be made of metal tubing (e.g., stainless steel). It is recommended that the external tubing diameter (dimension D_t, Figure 2-2b) be between 0.48 and 0.95 centimeters (3/16 and 3/8 inch). There shall be an equal distance from the base of each leg of the pitot tube to its face-opening plane (dimensions P_A and P_B, Figure 2-2b); it is recommended that this distance be between 1.05 and 1.50 times the external tubing diameter. The face openings of the pitot tube shall, preferably, be aligned as shown in Figure 2-2; however, slight misalignments of the openings are permissible (see Figure 2-3).

The Type S pitot tube shall have a known coefficient, determined as outlined in Section 4. An identification number shall be assigned to the pitot tube; this number shall be permanently marked or engraved on the body of the tube.

A standard pitot tube may be used instead of a Type S, provided that it meets the specifications of Sections 2.7 and 4.2; note, however, that the static and impact pressure holes of standard pitot tubes are susceptible to plugging in particulate-laden gas

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The Type S pitot tube shall have a known coefficient, determined as outlined in Section 4. An identification number shall be assigned to the pitot tube; this number shall be permanently marked or engraved on the body of the tube.

A standard pitot tube may be used instead of a Type S, provided that it meets the specifications of Sections 2.7 and 4.2; note, however, that the static and impact pressure holes of standard pitot tubes are susceptible to plugging in particulate-laden gas

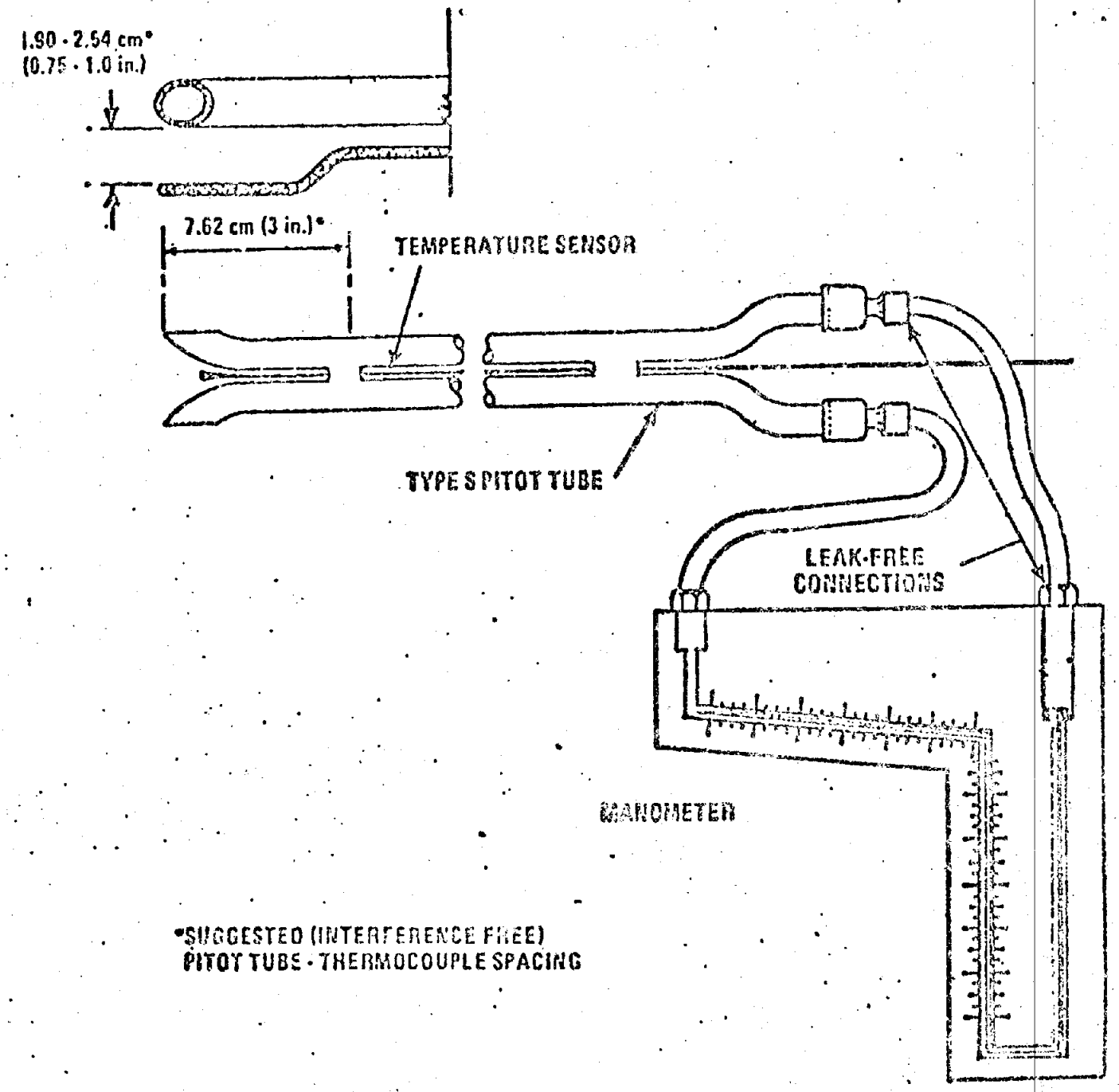


Figure 2-1. Type S pitot tube manometer assembly.

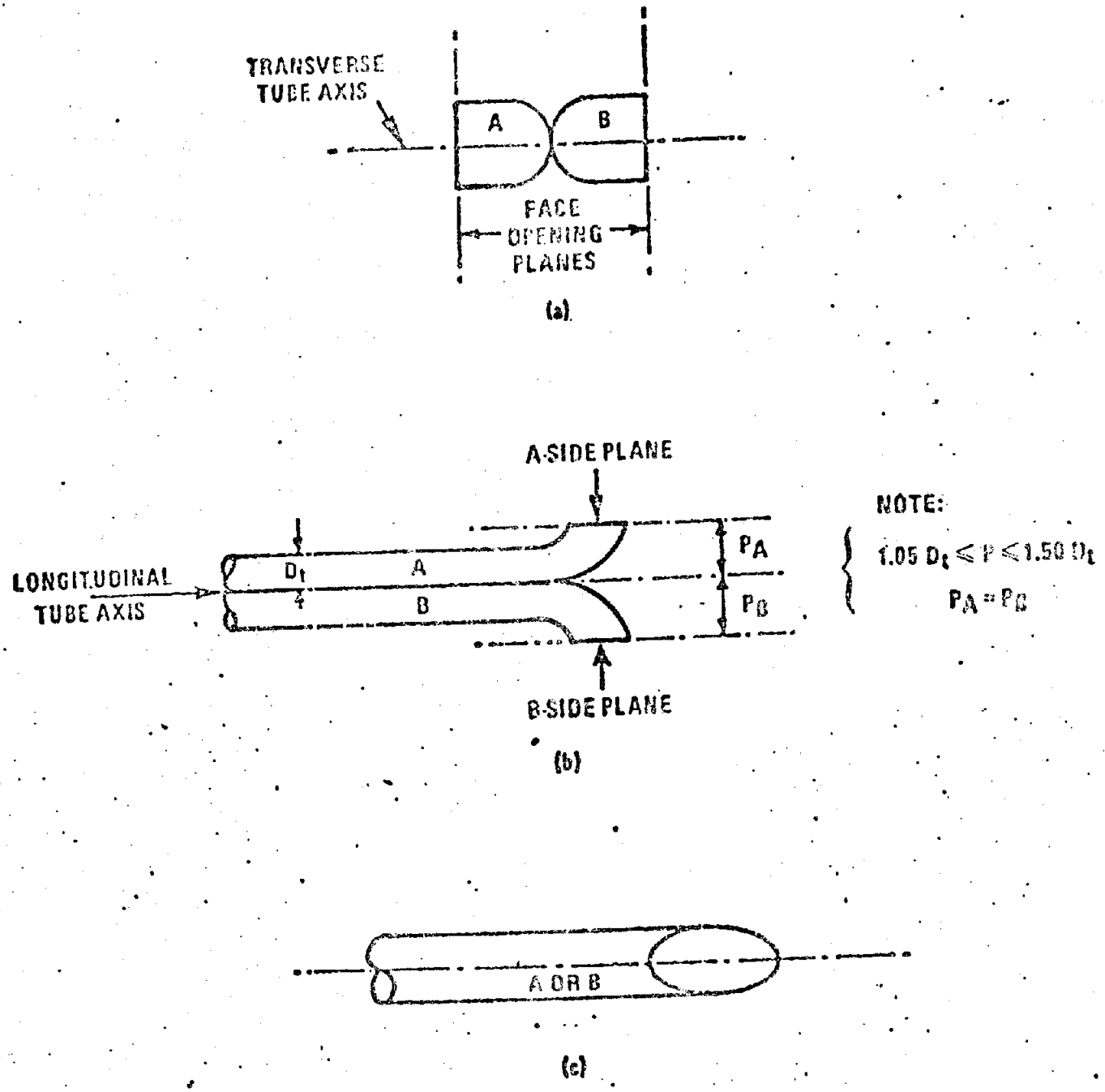
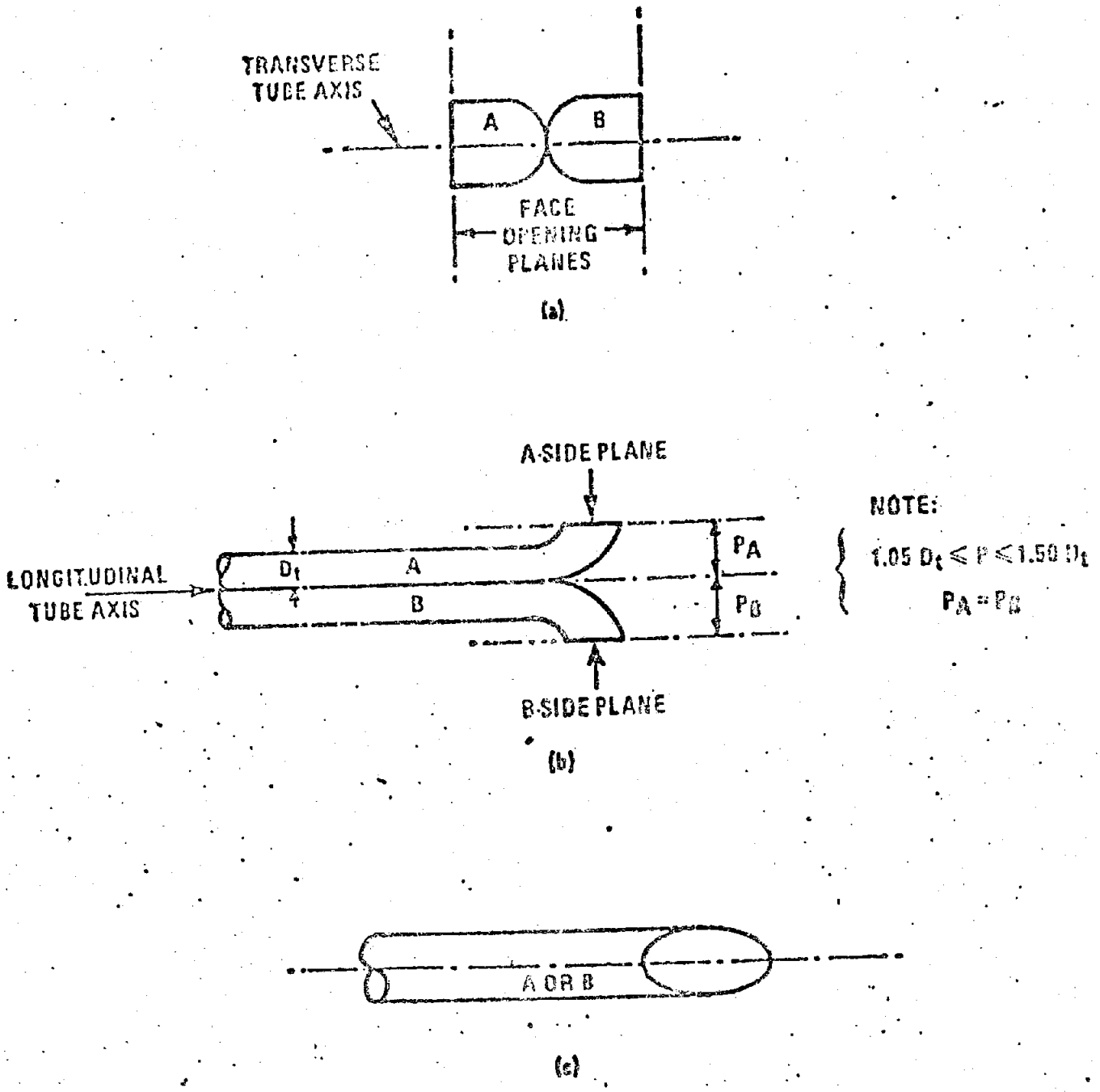


Figure 2-2. Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way.



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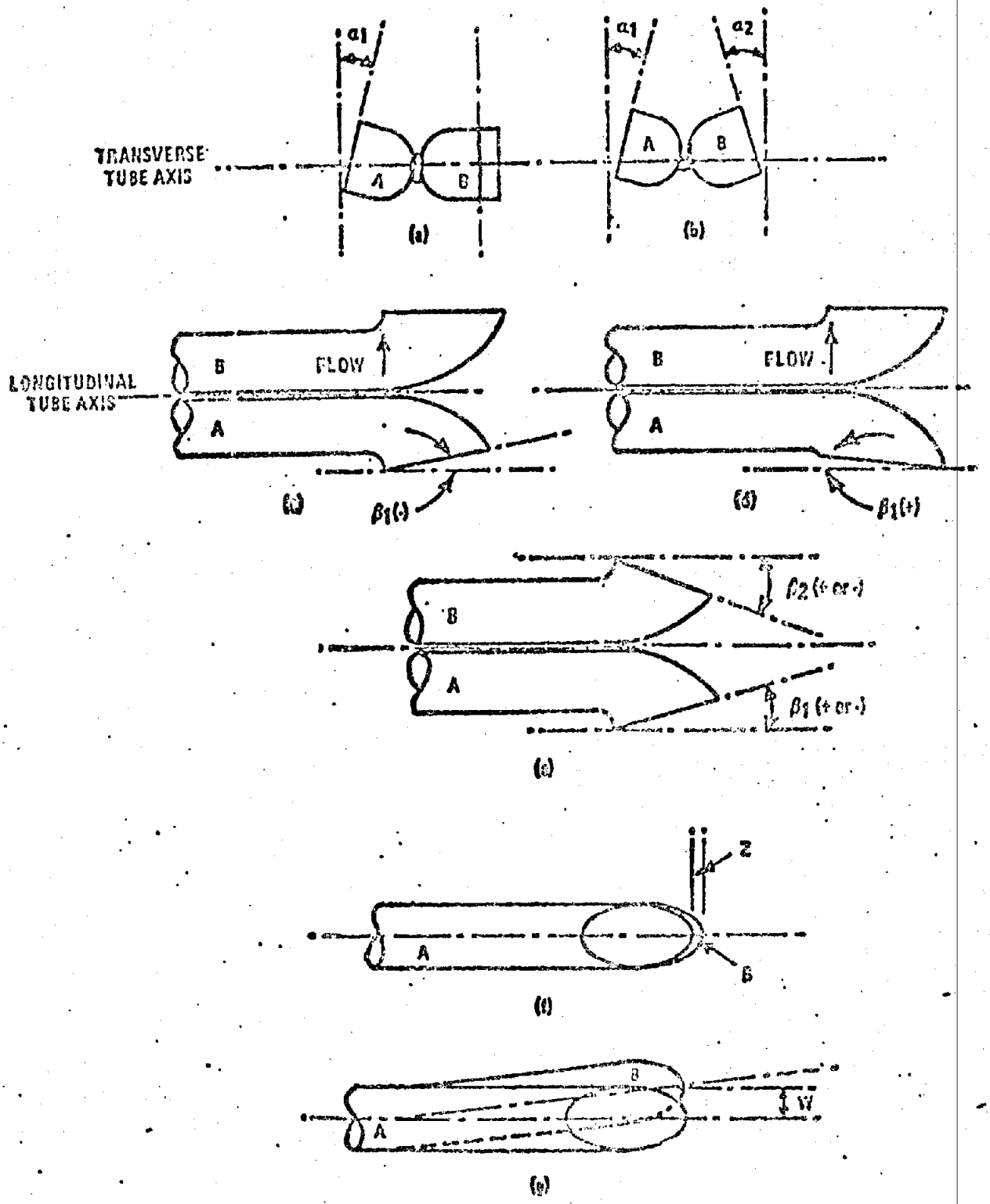

Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of $C_p(s)$ so long as α_1 and $\alpha_2 < 10^\circ$, β_1 and $\beta_2 < 5^\circ$, $z < 0.32$ cm (1/8 in.) and $w < 0.08$ cm (1/32 in.) (citation 11 in Section 6).

streams. Therefore, whenever a standard pitot tube is used to perform a traverse, adequate proof must be furnished that the openings of the pitot tube have not plugged up during the traverse period; this can be done by taking a velocity head (Δp) reading at the final traverse point, cleaning out the impact and static holes of the standard pitot tube by "back-purging" with pressurized air, and then taking another Δp reading. If the Δp readings made before and after the air purge are the same (± 5 percent) the traverse is acceptable. Otherwise, reject the run. Note that if Δp at the final traverse point is unsuitably low, another point may be selected. If "back-purging" at regular intervals is part of the procedure, then comparative Δp readings shall be taken, as above, for the last two back purges at which suitably high Δp readings are observed.

2.2 Differential Pressure Gauge. An inclined manometer or equivalent device is used. Most sampling trains are equipped with a 10-in. (water column) inclined-vertical manometer, having 0.01-in. H_2O divisions on the 0- to 1-in. inclined scale, and 0.1-in. H_2O divisions on the 1- to 10-in. vertical scale. This type of manometer (or other gauge of equivalent sensitivity) is satisfactory for the measurement of Δp values as low as 1.3 mm (0.05 in.) H_2O. However, a differential pressure gauge of greater sensitivity shall be used (subject to the approval of the Control Agency's Authorized Representative), if any of the following is found to be true: (1) the arithmetic average of all Δp readings at the traverse points in the stack is less than

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1.3 mm (0.05 in.) H_2O; (2) for traverses of 12 of more points, more than 10 percent of the individual Δp readings are below 1.3 mm (0.05 in.) H_2O; (3) for traverses of fewer than 12 points, more than one Δp reading is below 1.3 mm (0.05 in.) H_2O.

As an alternative to criteria (1) through (3) above, the following calculation may be performed to determine the necessity of using a more sensitive differential pressure gauge:

$$T = \frac{\sum_{i=i}^{n} \sqrt{p_i + K}}{\sum_{i=i}^{n} P_i}$$

where: Δp_i = Individual velocity head reading at a traverse point, mm H_2O (in. H_2O).

n = Total number of traverse points.

K = 0.13 mm H_2O when metric units are used and 0.005 in. H_2O when English units are used.

If T is greater than 1.05, the velocity head data are unacceptable and a more sensitive differential pressure gauge must be used.

Note: If differential pressure gauges other than inclined manometers are used (e.g., magnehelic gauges), their calibration must be checked after each test series. To check the calibration of a differential pressure gauge, compare Δp readings of the gauge with those of a gauge-oil manometer at a minimum of three

points, approximately representing the range of Δp values in the stack. If, at each point, the values of Δp as read by the differential pressure gauge and gauge-oil manometer agree to within 5 percent, the differential pressure gauge shall be considered to be in proper calibration. Otherwise, the test series shall either be voided, or procedures to adjust the measured Δp values and final results shall be used, subject to the approval of the Control Agency's Authorized Representative.

2.3 Temperature Gauge. A thermocouple, liquid-filled bulb thermometer, bimetallic thermometer, mercury-in-glass thermometer, or other gauge capable of measuring temperature to within 1.5 percent of the minimum absolute stack temperature shall be used. The temperature gauge shall be attached to the pitot tube such that the sensor tip does not touch any metal; the gauge shall be in an interference-free arrangement with respect to the pitot tube face openings (see Figure 2-1 and also Figure 2-7 in Section 4). Alternate positions may be used if the pitot tube temperature gauge system is calibrated according to the procedure of Section 4. Provided that a difference of not more than 1 percent in the average velocity measurement is introduced, the temperature gauge need not be attached to the pitot tube; this alternative is subject to the approval of the Control Agency's Authorized Representative.

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2.4 Pressure Probe and Gauge. A piezometer tube and mercury or water-filled U-tube manometer capable of measuring stack pressure to within 2.5 mm (0.1 in.) Hg is used. The static tap of a standard type pitot tube or one leg of a Type S pitot tube with the face opening planes positioned parallel to the gas flow may also be used as the pressure probe.

2.5 Barometer. A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) may be used. In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm (0.1 in.) Hg per 30-meter (100 foot) elevation increase, or vice-versa for elevation decrease.

2.6 Gas Density Determination Equipment. Method 3 equipment, if needed (see Section 3.6), to determine the stack gas dry molecular weight, and Method 4 or Method 5 equipment for moisture content determination; other methods may be used subject to approval of the Control Agency's Authorized Representative.

2.7 Calibration Pitot Tube. When calibration of the Type S pitot tube is necessary (see Section 4), a standard pitot tube is used

as a reference. The standard pitot tube shall, preferably, have a known coefficient, obtained either (1) directly from the National Bureau of Standards, Route 270, Quince Orchard Road, Gaithersburg, Maryland, or (2) by calibration against another standard pitot tube with an NBS-traceable coefficient. Alternatively, a standard pitot tube designed according to the criterion given in 2.7.1 through 2.7.5 below and illustrated in Figure 2.4 (see also Citations 7, 8, and 17 in Section 6) may be used. Pitot tubes designed according to these specifications will have baseline coefficients of about 0.99 $\pm$0.01.

2.7.1 Hemispherical (shown in Figure 2-4), ellipsoidal, or conical tip.

2.7.2 A minimum of six diameters straight run (based upon D, the external diameter of the tube) between the tip and the static pressure holes.

2.7.3 A minimum of eight diameters straight run between the static pressure holes and the centerline of the external tube, following the 90 degree bend.

2.7.4 Static pressure holes of equal size (approximately 0.1 D), equally spaced in a piezometer ring configuration.

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2.7.3 A minimum of eight diameters straight run between the static pressure holes and the centerline of the external tube, following the 90 degree bend.

2.7.4 Static pressure holes of equal size (approximately 0.1 D), equally spaced in a piezometer ring configuration.

2.7.5 Ninety degree bend, with curved or mitered junction.

2.8 Differential Pressure Gauge for Type S Pitot Tube Calibration An inclined manometer or equivalent is used. If the single-velocity calibration technique is employed (see Section 4.1.2.3), the calibration differential pressure gauge shall be readable to the nearest 0.13 mm H_2O (0.005 in. H_2O). For multivelocity calibrations, the gauge shall be readable to the nearest 0.13 mm H_2O (0.005 in. H_2O) for p values between 1.3 and 25 mm H_2O (0.05 and 1.0 in. H_2O), and to the nearest 1.3 mm H_2O (0.05 in. H_2O) for Δp values above 25 mm H_2O (1.0 in. H_2O). A special, more sensitive gauge will be required to read Δp values below 1.3 mm H_2O (0.05 in. H_2O) (see Citation 18 in Section 6).

3. Procedure

3.1 Set up the apparatus as shown in Figure 2-1. Capillary tubing or surge tanks installed between the manometer and pitot tube may be used to dampen p fluctuations. Conduct a pretest leak-check as follows: (1) blow through the pitot impact opening until at least 7.6 cm (3 in. H_2O) velocity pressure registers on the manometer; then, close off the impact opening. The pressure shall remain stable for at least 15 seconds; (2) do the same for the static pressure side, except using suction to obtain the minimum of 7.6 cm (3 in. H_2O). Other leak-check procedures, subject to the approval of the Control Agency's Authorized Representative, may be used.

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3.2 Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse. Record all necessary data as shown in the example or similar data sheet (Figure 2-5).

3.3 Measure the velocity head and temperature at the traverse points specified by Method 1. Ensure that the proper differential pressure gauge is being used for the range of p values encountered (see Section 2.2). If it is necessary to change to a more sensitive gauge, do so, and remeasure the p and temperature readings at each traverse point. Conduct a post-test leak-check (mandatory), as described in Section 3.1 above to validate the traverse run.

3.4 Measure the static pressure in the stack. One reading is usually adequate.

3.5 Determine the atmospheric pressure.

3.6 Determine the stack gas dry molecular weight. For combustion processes or processes that emit essentially CO_2, O_2, CO, and N_2, use Method 3. For processes emitting essentially air, an analysis need not be conducted; use a dry molecular weight of 29.0. For other processes, other methods, subject to the approval of the Control Agency's Authorized Representative, must be used.

VELOCITY TRAVERSE DATA

Traverse Point Number	Velocity Head in. H_2O	Distance from inside wall (in.)	Stack Temperature (T_s), °F	Velocity Head in. H_2O	$\sqrt{\Delta P}$	Stack Temperature (T_s), °F
Average						

Plant _____

Sampling Site _____

Remarks _____

_____

Barometric Pressure, in. Hg _____

Static Pressure in Stack (P_g) in. Hg _____

Operators _____ Date _____

Pitot Tube Factor ---

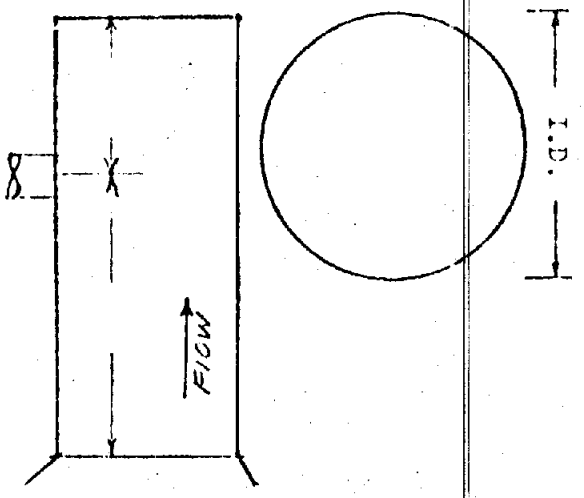

FIGURE 2-5 VELOCITY TRAVERSE DATA

VELOCITY TRAVERSE DATA

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Average						

Plant _____

Sampling Site _____

Remarks _____

_____

Barometric Pressure, in. Hg _____

Static Pressure in Stack (P_g) in. Hg _____

Operators _____ Date _____

Pitot Tube Factor _____

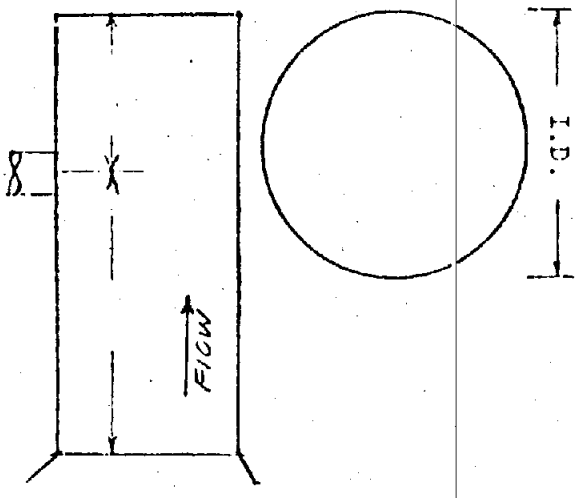

FIGURE 2-5 VELOCITY TRAVERSE DATA

3.7 Obtain the moisture content from Reference Method 4 (or equivalent) or from Method 5.

3.8 Determine the cross-sectional area of the stack or duct at the sampling location. Whenever possible, physically measure the stack dimensions rather than using blueprints.

4. Calibration

4.1 Type S Pitot Tube. Before its initial use, carefully examine the Type S pitot tube in top, side, and end views to verify that the face openings of the tube are aligned within the specifications illustrated in Figure 2-2 or 2-3. The pitot tube shall not be used if it fails to meet these alignment specifications.

After verifying the face opening alignment, measure and record the following dimensions of the pitot tube: (a) the external tubing diameter (dimension D_t Figure 2-2b); and (b) the base-to opening plane distances (dimensions P_A and P_B Figure 2-2b). If D_t is between 0.48 and 0.95 cm (3/16 and 3/8 in.) and if P_A and P_B are equal and between 1.05 and 1.50 D_t, there are two possible options: (1) the pitot tube may be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, or (2) a baseline (isolated tube) coefficient value of 0.84 may be assigned to the pitot tube. Note, however, that if the pitot tube is part of an assembly, calibration may still be required, despite knowledge of the baseline coefficient value (see Section 4.1.1).

If D_t, P_A, and P_B are outside the specified limits, the pitot tube must be calibrated as outlined in 4.1.2 through 4.1.5 below.

4.1.1 Type S Pitot Tube Assemblies. During sample and velocity traverses, the isolated Type S pitot tube is not always used; in many instances, the pitot tube is used in combination with other source-sampling components (thermocouple, sampling probe, nozzle) as part of an "assembly." The presence of other sampling components can sometimes affect the baseline value of the Type S pitot tube coefficient (Citation 9 in Section 6); therefore, an assigned (or otherwise known) baseline coefficient value may or may not be valid for a given assembly.

The baseline and assembly coefficient values will be identical only when the relative placement of the components in the assembly is such that aerodynamic interference effects are eliminated. Figures 2-6 through 2-8 illustrate interference-free component arrangements for Type S pitot tubes having external tubing diameters between 0.48 and 0.95 cm (3/16 and 3/8 in.). Type S pitot tube assemblies that fail to meet any or all of the specifications of Figures 2-6 through 2-8 shall be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, and prior to calibration, the

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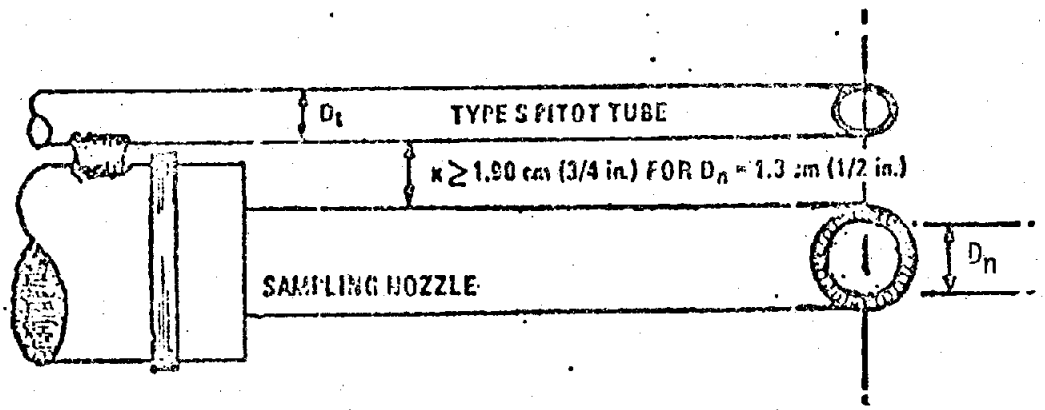
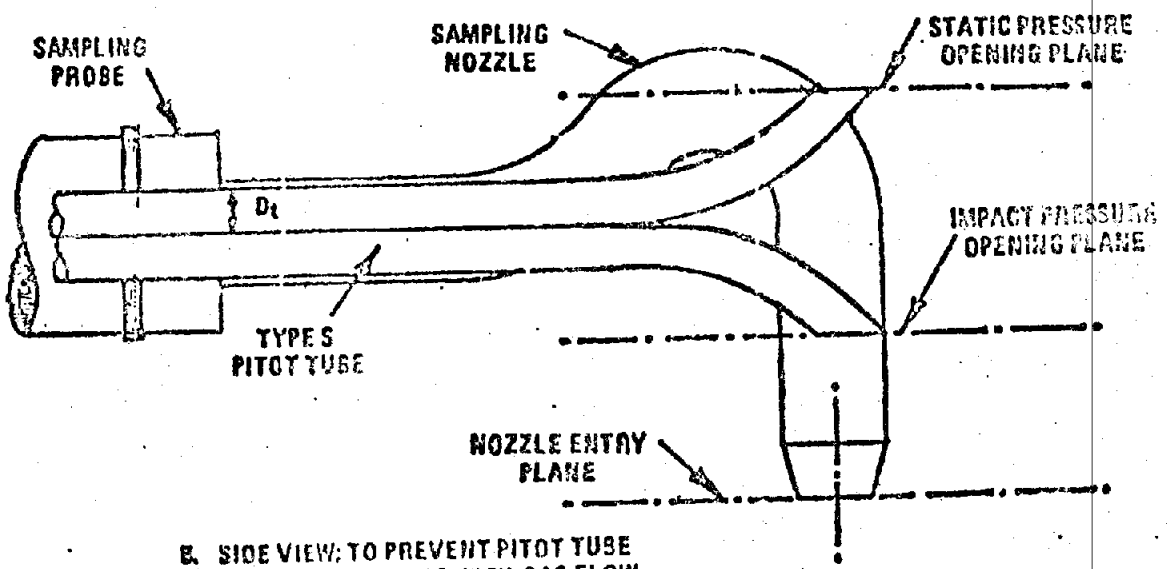
in a flow system having the following essential design features:



A. BOTTOM VIEW: SHOWING MINIMUM PITOT-NOZZLE SEPARATION.



B. SIDE VIEW: TO PREVENT PITOT TUBE FROM INTERFERING WITH GAS FLOW STREAMLINES APPROACHING THE NOZZLE, THE IMPACT PRESSURE OPENING PLANE OF THE PITOT TUBE SHALL BE EVEN WITH OR ABOVE THE NOZZLE ENTRY PLANE.

Figure 2-6. Proper pitot tube - sampling nozzle configuration to prevent aerodynamic interference; buttonhook - type nozzle; centers of nozzle and pitot opening aligned; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

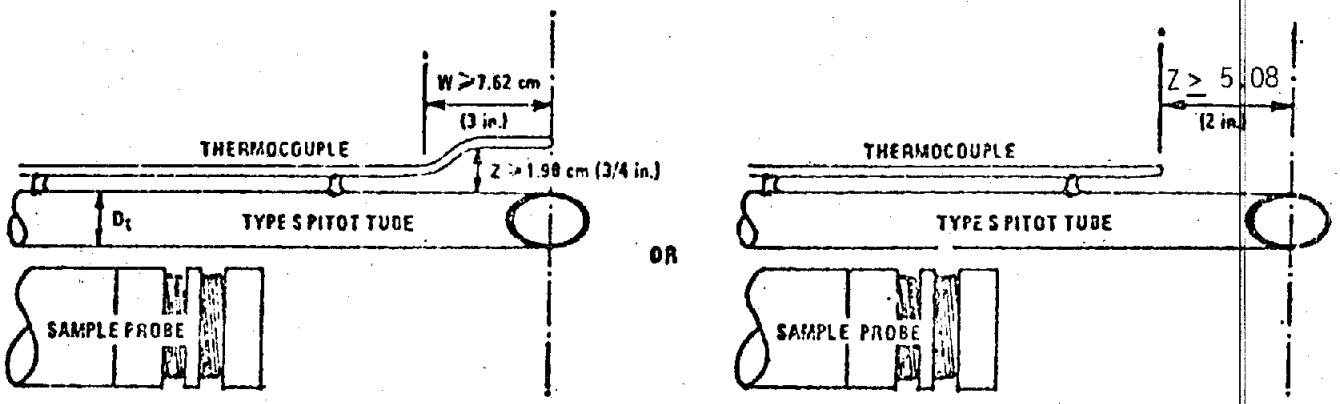


Figure 2-7. Proper thermocouple placement to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

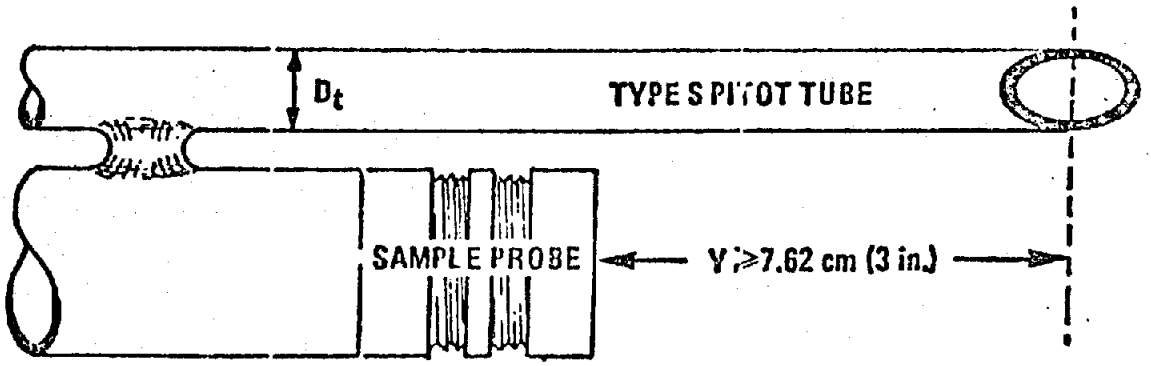
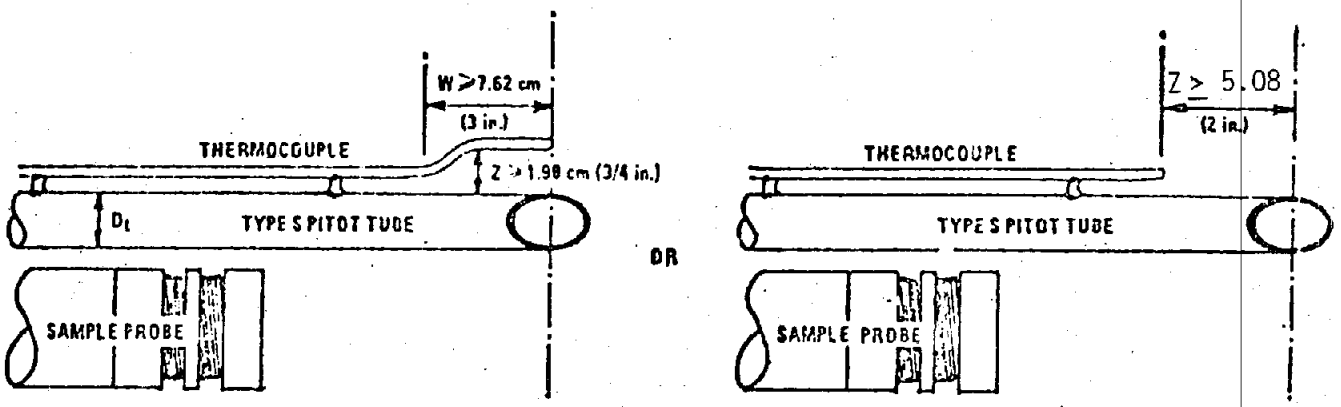


Figure 2-8. Minimum pitot-sample probe separation needed to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).



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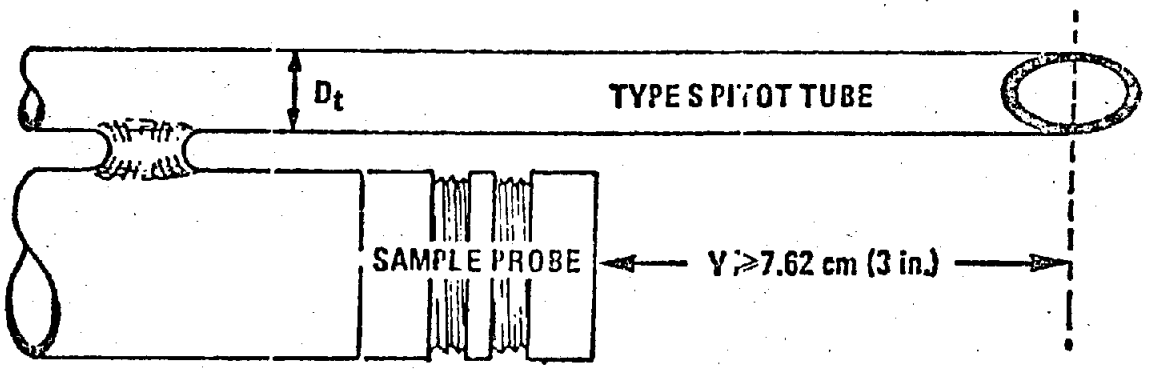

Figure 2-8. Minimum pitot-sample probe separation needed to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

values of the intercomponent spacings (pitot-nozzle, pitot-thermocouple, pitot-probe sheath) shall be measured and recorded.

Note: Do not use any Type S pitot tube assembly which is constructed such that the impact pressure opening plane of the pitot tube is below the entry plane of the nozzle (see Figure 2-6b).

4.1.2 Calibration Setup. If the Type S pitot tube is to be calibrated, one leg of the tube shall be permanently marked A, and the other, B. Calibration shall be done in a flow system having the following essential design features:

4.1.2.1 The flowing gas stream must be confined to a duct circular or rectangular. For circular cross-sections, the minimum duct diameter shall be 30.5 cm (12 in.); for rectangular cross-sections, the width (shorter side) shall be at least 25.4 cm (10 in.).

4.1.2.2 The cross-sectional area of the calibration duct must be constant over a distance of 10 or more duct diameters. For a rectangular cross-section, use an equivalent diameter, calculated from the

following equation, to determine the number of duct diameters:

$$D_e = \frac{2\,LW}{(L + W)}$$

Equation 2-1

where: D_e = Equivalent diameter

L = Length

W = Width

To ensure the presence of stable, fully developed flow patterns at the calibration site, or "test section," the site must be located eight diameters downstream and two diameters upstream from the nearest disturbances.

Note: The eight- and two-diameter criteria are not absolute; other test section locations may be used (subject to approval of the Control Agency's Authorized Representative), provided that the flow at the test site is stable and demonstrably parallel to the duct axis.

4.1.2.3 The flow system shall have the capacity to generate a test-section velocity around 915 m/min (3,000 ft/min). This velocity must be constant with time to guarantee steady flow during

following equation, to determine the number of duct diameters:

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Equation 2-1

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4.1.2.3 The flow system shall have the capacity to generate a test-section velocity around 915 m/min (3,000 ft/min). This velocity must be constant with time to guarantee steady flow during

calibration. Note that Type S pitot tube coefficients obtained by single-velocity calibration at 915 m/min (3,000 ft/min) will generally be valid to within ±3 percent for the measurement of velocities above 305 m/min (1,000 ft/min) and to within ±5 to 6 percent for the measurement of velocities between 180 and 305 m/min (600 and 1,000 ft/min). If a more precise correlation between C_p and velocity is desired, the flow system shall have the capacity to generate at least four distinct, time-invariant test-section velocities covering the velocity range from 180 to 1,525 m/min (600 to 5,000 ft/min), and calibration data shall be taken at regular velocity intervals over this range (see Citations 9 and 14 in Section 6 for details).

4.1.2.4 Two entry ports, one each for the standard and Type S pitot tubes, shall be cut in the test section; the standard pitot entry port shall be located slightly downstream of the Type S port, so that the standard and Type S impact openings will lie in the same cross-sectional plane during calibration. To facilitate alignment of the pitot tubes during calibration, it is advisable that the test section be constructed of plexiglas or some other transparent material.

4.1.3 Calibration Procedure. Note that this procedure is a general one and must not be used without first referring to the special considerations presented in Section 4.1.5. Note also that this procedure applies only to single-velocity calibration. To obtain calibration data for the A and B sides of the Type S pitot tube, proceed as follows:

4.1.3.1 Make sure that the manometer is properly filled and that the oil is free from contamination and is of the proper density. Inspect and leak-check all pitot lines; repair or replace if necessary.

4.1.3.2 Level and zero the manometer. Turn on the fan and allow the flow to stabilize. Seal the Type S entry port.

4.1.3.3 Ensure that the manometer is level and zeroed. Position the standard pitot tube at the calibration point (determined as outlined in Section 4.1.5.1), and align the tube so that its tip is pointed directly into the flow. Particular care should be taken in aligning the tube to avoid yaw and pitch angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3 Calibration Procedure. Note that this procedure is a general one and must not be used without first referring to the special considerations presented in Section 4.1.5. Note also that this procedure applies only to single-velocity calibration. To obtain calibration data for the A and B sides of the Type S pitot tube, proceed as follows:

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4.1.3.2 Level and zero the manometer. Turn on the fan and allow the flow to stabilize. Seal the Type S entry port.

4.1.3.3 Ensure that the manometer is level and zeroed. Position the standard pitot tube at the calibration point (determined as outlined in Section 4.1.5.1), and align the tube so that its tip is pointed directly into the flow. Particular care should be taken in aligning the tube to avoid yaw and pitch angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.4 Read Δp_{std} and record its value in data table similar to the one shown in Figure 2-9. Remove the standard pitot tube from the duct and disconnect it from the manometer. Seal the standard entry port.

4.1.3.5 Connect the Type S pitot tube to the manometer. Open the Type S entry port. Check the manometer level and zero insert and align the Type S pitot tube so that its A side impact opening is at the same point as was the standard pitot tube and is pointed directly into the flow. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.6 Read Δp_s and enter its value in the data table. Remove the Type S pitot tube from the duct and disconnect it from the manometer.

4.1.3.7 Repeat steps 4.1.3.3 through 4.1.3.6 above until three pairs of p readings have been obtained.

4.1.3.8 Repeat steps 4.1.3.2 through 4.1.3.7 above for the B side of the Type S pitot tube.

PITOT TUBE IDENTIFICATION NUMBER: _____ DATE: _____

CALIBRATED BY: _____

	"A" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(A)$
1				
2				
3				
		$\bar{C}_p$ (SIDE A)		

	"B" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(B)$
1				
2				
3				
		$\bar{C}_p$ (SIDE B)		

$$\text{AVERAGE DEVIATION} = \sigma(\text{A OR B}) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \bar{C}_p(\text{A OR B}) \right|}{3} \leftarrow \text{MUST BE} \leq 0.01$$

$$\left| \bar{C}_p \text{ (SIDE A)} - \bar{C}_p \text{ (SIDE B)} \right| \leftarrow \text{MUST BE} \leq 0.01$$

Figure 2-9. Pitot tube calibration data.

PITOT TUBE IDENTIFICATION NUMBER: _____ DATE: _____

CALIBRATED BY: _____

	"A" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(A)$
1				
2				
3				
		$\bar{C}_p$ (SIDE A)		

	"B" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(B)$
1				
2				
3				
		$\bar{C}_p$ (SIDE B)		

$$\text{AVERAGE DEVIATION} = \sigma\,(\text{A OR B}) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \bar{C}_p(\text{A OR B}) \right|}{3} \rightarrow \text{MUST BE} \leq 0.01$$

$$\left| \bar{C}_p\,(\text{SIDE A}) - \bar{C}_p\,(\text{SIDE B}) \right| \rightarrow \text{MUST BE} \leq 0.01$$

Figure 2-9. Pitot tube calibration data.

4.1.3.9 Perform calculations, as described in Section 4.1.4 below.

4.1.4 Calculations

4.1.4.1 For each of the six pairs of p readings (i.e., three from side A and three from side B) obtained in Section 4.1.3 above, calculate the value of the Type S pitot tube coefficient as follows:

$$C_{p(s)} = C_{p(std)}\sqrt{\frac{\Delta P_{std}}{\Delta p_s}}$$

Equation 2-2

where: $C_{p(s)}$ = Type S pitot tube coefficient

$C_{p(std)}$ = Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the criteria of Sections 2.7.1 to 2.7.5 of this method.

ΔP_{std} = Velocity head measured by the standard pitot tube, cm H_2O (in. H_2O)

Δp_s = Velocity head measured by the Type S pitot tube, cm H_2O (in. H_2O)

4.1.4.2 Calculate $\overline{C}_p$ (side A), the mean A side coefficient, and $\overline{C}_p$ (side B), the mean B-side coefficient; calculate the difference between these two average values.

4.1.4.3 Calculate the deviation of each of the three A-side values of $C_{p(s)}$ from $\overline{C}_p$ (side A), and the deviation of each B-side value of $C_{p(s)}$ from $\overline{C}_p$ (side B). Use the following equation:

$$\text{Deviation} = C_{p(s)} - \overline{C}_p(\text{A or B})$$

Equation 2-3

4.1.4.4 Calculate a, the average deviation from the mean, for both the A and B sides of the pitot tube. Use the following equation:

$$a(\text{side A or B}) = \frac{\sum_{1}^{3} [C_{p(\overline{s})} - C_p(\text{A or B})]}{3}$$

Equation 2-4

4.1.4.5 Use the Type S pitot tube only if the values of (side A) and (side B) are less than or equal to 0.01 and if the absolute value of the difference between $\overline{C}_p$ (A) and $\overline{C}_p$ (B) is 0.01 or less.

4.1.5 Special Considerations

4.1.5.1 Selection of Calibration Point

4.1.5.1.1 When an isolated Type S pitot tube is calibrated, select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The Type S pitot coefficients so obtained, i.e., $\overline{C}_p$ (side A) and $\overline{C}_p$ (side B), will be valid, so long as either: (1) the isolated pitot tube is used; or (2) the pitot tube is used with other components

4.1.4.3 Calculate the deviation of each of the three A-side values of $C_{p(s)}$ from $\overline{C}_p$ (side A), and the deviation of each B-side value of $C_{p(s)}$ from $\overline{C}_p$ (side B). Use the following equation:

$$\text{Deviation} = C_{p(s)} - \overline{C}_p(\text{A or B})$$

Equation 2-3

4.1.4.4 Calculate a, the average deviation from the mean, for both the A and B sides of the pitot tube. Use the following equation:

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Equation 2-4

4.1.4.5 Use the Type S pitot tube only if the values of (side A) and (side B) are less than or equal to 0.01 and if the absolute value of the difference between $\overline{C}_p$ (A) and $\overline{C}_p$ (B) is 0.01 or less.

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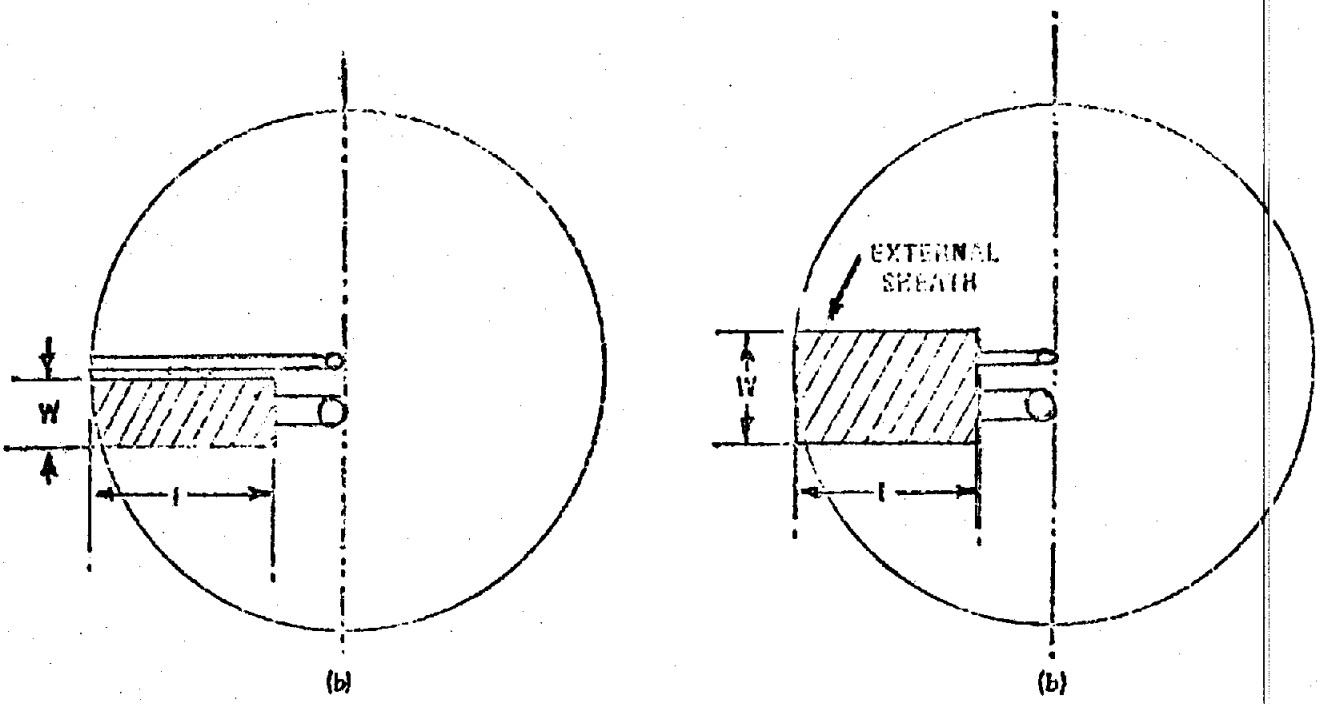
4.1.5.1.1 When an isolated Type S pitot tube is calibrated, select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The Type S pitot coefficients so obtained, i.e., $\overline{C}_p$ (side A) and $\overline{C}_p$ (side B), will be valid, so long as either: (1) the isolated pitot tube is used; or (2) the pitot tube is used with other components

(nozzle, thermocouple, sample probe) in an arrangement that is free from aerodynamic interference effects (see Figures 2-6 through 2-8).

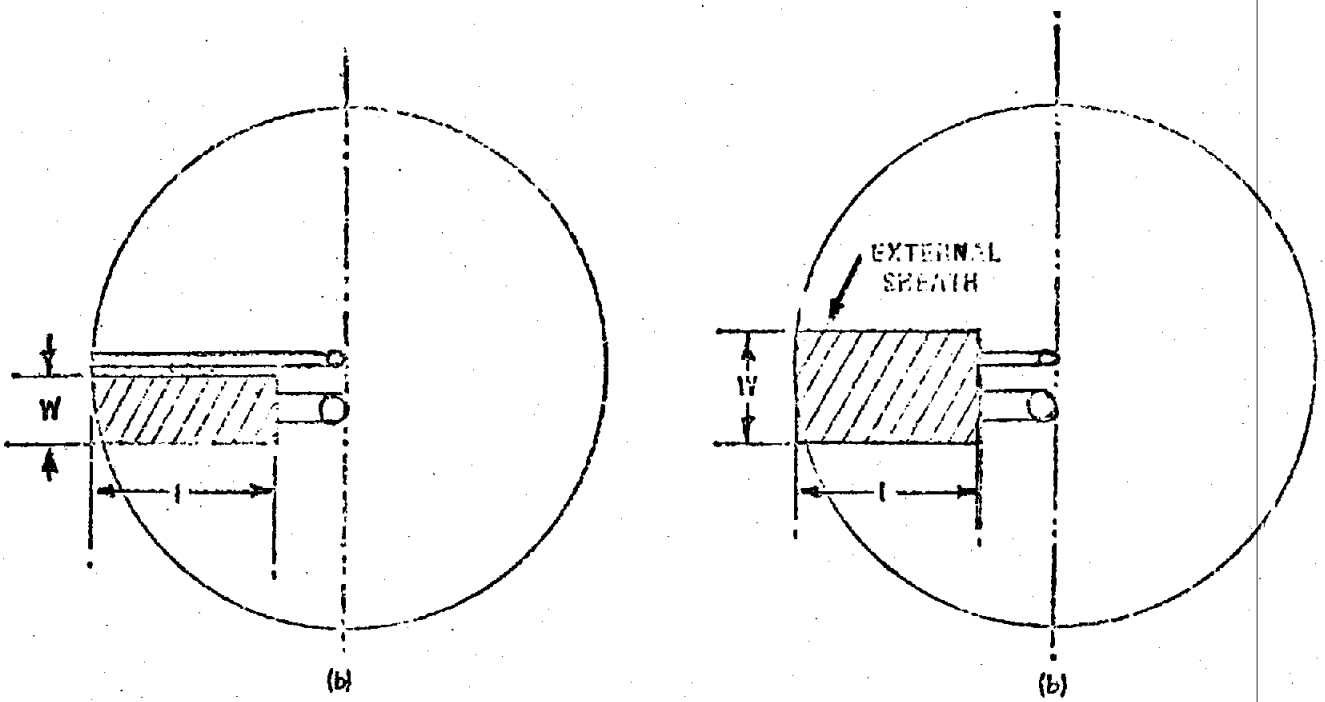
4.1.5.1.2 For Type S pitot tube-thermocouple combinations (without sample probe), select a calibration point at or near the center of the duct;, and follow the procedures outlined in Section 4.1.3 and 4.1.4 above. The coefficients so obtained will be valid so long as the pitot tube-thermocouple combination is used by itself or with other components in an interference-free arrangement (Figures 2-6 and 2-8).

4.1.5.1.3 For assemblies with sample probes, the calibration point should be located at or near the center of the duct; however, insertion of the probe sheath into a small duct may cause significant cross-sectional area blockage and yield incorrect coefficient values (Citation 9). Therefore, to minimize the blockage effect, the calibration point may be a few inches off center if necessary. The actual blockage effect will be negligible when the theoretical blockage, as determined by a projected area model of the probe sheath, is two percent or less of the duct cross-sectional area for assemblies without external sheaths (Figure 2-10a), and three percent or less for assemblies with external sheaths (Figure 2-10b).



$$\text{ESTIMATED SHEATH BLOCKAGE (\%)} = \left[\frac{l \times W}{\text{DUCT AREA}}\right] \times 100$$

Figure 2-10. Projected area models for typical pitot tube assemblies.



$$\text{ESTIMATED SHEATH BLOCKAGE (\%)} = \left[\frac{l \times W}{\text{DUCT AREA}}\right] \times 100$$

Figure 2-10. Projected area models for typical pitot tube assemblies.

4.1.5.2 For those probe assemblies in which pitot tube nozzle interference is a factor (i.e., those in which the pitot-nozzle separation distance fails to meet the specification illustrated in Figure 2-6a), the value of $C_{p(s)}$ depends upon the amount of free-space between the tube and nozzle, and therefore is a function of nozzle size. In these instances, separate calibrations shall be performed with each of the commonly used nozzle sizes in place. Note that the single-velocity calibration technique is acceptable for this purpose, even though the larger nozzle sizes (>0.635 cm or 1/4 in.) are not ordinarily used for isokinetic sampling at velocities around 915 m/min. (3,000 ft/min.), which is the calibration velocity; note also that it is not necessary to draw an isokinetic sample during calibration. (Citation 9 in Section 6.)

4.1.5.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation (a) value of 0.01 or less (see Section 4.1.4.4).

4.1.6 Field Use and Recalibration

4.1.6.1 Field Use

4.1.6.1.1 When a Type S pitot tube (isolated tube or assembly) is used in the field, the appropriate coefficient value (whether assigned or obtained by calibration) shall be used to perform velocity calculations. For calibrated Type S pitot tubes, the A side coefficient shall be used when the A side of the tube faces the flow, and the B side coefficient shall be used when the B side faces the flow; alternatively, the arithmetic average of the A and B side coefficient values may be used, irrespective of which side faces the flow.

4.1.6.1.2 When a probe assembly is used to sample a small duct (12 to 36 in. in diameter), the probe sheath sometimes blocks a significant part of the duct cross-section, causing a reduction in the effective value of $C_{p(s)}$. Conventional pitot-sampling probe assemblies are not recommended for use in ducts having inside diameters smaller than 12 inches. (Citation 16 in Section 6.)

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4.1.6.2 Recalibration

4.1.6.2.1 Isolated Pitot Tubes. After each field use, the pitot tube shall be carefully reexamined in top, side, and end views. If the pitot face openings are still aligned within the specifications illustrated in Figure 2-2 or 2-3, it can be assumed that the baseline coefficient of the pitot tube has not changed. If, however, the tube has been damaged to the extent that it no longer meets the specifications of Figure 2-2 or 2-3, the damage shall either be repaired to restore proper alignment of the face openings or the tube shall be discarded.

4.1.6.2.2 Pitot Tube Assemblies. After each field use, check the face opening alignment of the pitot tube, as in Section 4.1.6.2.1; also, remeasure the intercomponent spacings of the assembly. If the intercomponent spacings have not changed and the face opening alignment is acceptable, it can be assumed that the coefficient of the assembly has not changed. If the face opening alignment is no longer within the specifications of Figures 2-2 or 2-3, either repair the damage or replace the pitot tube (calibrating the new assembly, if

necessary). If the intercomponent spacings have changed, restore the original spacings or recalibrate the assembly.

4.2 Standard pitot tube (if applicable). If a standard pitot tube is used for the velocity traverse, the tube shall be constructed according to the criteria of Section 2.7 and shall be assigned a baseline coefficient value of 0.99. If the standard pitot tube is used as part of an assembly, the tube shall be in an interference-free arrangement (subject to the approval of the Control Agency's Authorized Representative).

4.3 Temperature Gauges. After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other gauges at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405°C (761°F), use an NBS-calibrated reference thermocouple-potentiometer system or an alternate reference, subject to the approval of the Control Agency's Authorized Representative.

If, during calibration, the absolute temperatures measured with the gauge being calibrated and the reference gauge agree within 1.5 percent, the temperature data taken in the field shall be considered valid. Otherwise, the pollutant emission test shall either be considered invalid or adjustments (if appropriate) of

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If, during calibration, the absolute temperatures measured with the gauge being calibrated and the reference gauge agree within 1.5 percent, the temperature data taken in the field shall be considered valid. Otherwise, the pollutant emission test shall either be considered invalid or adjustments (if appropriate) of

the test results shall be made, subject to the approval of the Control Agency's Authorized Representative.

4.4 Barometer. Calibrate the barometer used against a mercury barometer.

5. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

5.1 Nomenclature

A = Cross-sectional area of stack, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.

C_p = Pitot tube coefficient, dimensionless.

K_p = Pitot tube constant.

$$34.97 \frac{m}{sec} \left[\frac{(g/g\text{-mole})\ (mm\ Hg)}{(^oK)\ (mm\ H_2O)}\right]^{1/2}$$

for the metric system and

$$85.49 \frac{ft}{sec} \left[\frac{(lb/lb\text{-mole})\ (in.\ Hg)}{(^oR)\ (in.\ H_2O)}\right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).

M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$= M_d (1-Bws) + 18.0\ Bws$

Equation 2-5

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).

P_g = Stack static pressure, mm Hg (in. Hg).

P_s = Absolute stack gas pressure, mm Hg (in. Hg).

$= P_{bar} + P_g$

Equation 2-6

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).

t_s = Stack temperature ^oC (^oF).

T_s = Absolute stack temperature, ^oK (^oR).

$= 273 + t_s$ for metric

Equation 2-7

$= 460 + t_s$ for English

Equation 2-8

T_{std} = Standard absolute temperature, 293°K (528°R)

V_s = Average stack gas velocity, m/sec (ft/sec).

p = Velocity head of stack gas, mm H_2O (in. H_2O).

3,600 = Conversion factor, sec/hr.

18.0 = Molecular weight of water, g/g-mole (lb-lb-mole).

M_d = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).

M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

= M_d (1-Bws) + 18.0 Bws

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METHOD 3 - GAS ANALYSIS FOR CARBON DIOXIDE, OXYGEN, EXCESS AIR, AND DRY MOLECULAR WEIGHT

1. Principle and Applicability

1.1 Principle: A gas sample is extracted from a stack, by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent carbon dioxide (CO_2), percent oxygen (O_2), and, if necessary, percent carbon monoxide (CO). If a dry molecular weight determination is to be made, either an Orsat or a Fyrite[1/] analyzer or other analyzers specified in Method 100 may be used for the analysis; for excess air or emission rate correction factor determination, an Orsat analyzer or analyzers specified in Method 100 must be used.

1.2 Applicability: This method is applicable for determining CO_2 and O_2 concentrations, excess air, and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process. The method may also be applicable to other processes where it has been determined that compounds other than CO_2, O_2, CO, and nitrogen (N_2) are not present in concentration sufficient to affect the results.

1/ Mention of trade names or specific products does not constitute endorsement by the Air Resources Board.

Other methods, as well as modifications to the procedure described herein, are also applicable for some or all of the above determinations. Examples of specific methods and modifications include: (1) a multi-point sampling method using an Orsat analyzer to analyze individual grab samples obtained at each point; (2) a method using CO_2 or O_2 and stoichiometric calculations to determine dry molecular weight and excess air; (3) assigning a value of 30.0 for dry molecular weight, in lieu of actual measurements, for processes burning natural gas, coal, or oil. These methods and modifications may be used, but are subject to the approval of the Control Agency's Authorized Representative.

2. Apparatus

As an alternative to the sampling apparatus and systems described herein, other sampling systems (e.g., liquid displacement) may be used provided such systems are capable of obtaining a representative sample and maintaining a constant sampling rate, and are otherwise capable of yielding acceptable results. Use of such systems is subject to the approval of the Control Agency's Authorized Representative.

2.1 Grab Sampling (Figure 3-1)

2.1.1 Probe. The probe should be made of stainless steel or borosilicate glass tubing and should be equipped with an in-stack or out-stack filter to remove particulate matter (a

Other methods, as well as modifications to the procedure described herein, are also applicable for some or all of the above determinations. Examples of specific methods and modifications include: (1) a multi-point sampling method using an Orsat analyzer to analyze individual grab samples obtained at each point; (2) a method using CO_2 or O_2 and stoichiometric calculations to determine dry molecular weight and excess air; (3) assigning a value of 30.0 for dry molecular weight, in lieu of actual measurements, for processes burning natural gas, coal, or oil. These methods and modifications may be used, but are subject to the approval of the Control Agency's Authorized Representative.

2. Apparatus

As an alternative to the sampling apparatus and systems described herein, other sampling systems (e.g., liquid displacement) may be used provided such systems are capable of obtaining a representative sample and maintaining a constant sampling rate, and are otherwise capable of yielding acceptable results. Use of such systems is subject to the approval of the Control Agency's Authorized Representative.

2.1 Grab Sampling (Figure 3-1)

2.1.1 Probe. The probe should be made of stainless steel or borosilicate glass tubing and should be equipped with an in-stack or out-stack filter to remove particulate matter (a

plug of glass wool is satisfactory for this purpose). Any other material inert to O_2, CO_2, CO, and N_2 and resistant to temperature at sampling conditions may be used for the probe; examples of such material are aluminum, copper, quartz glass and Teflon.

2.1.2 Pump. A one-way squeeze bulb, or equivalent, is used to transport the gas sample to the analyzer.

2.2 Integrated Sampling (Figure 3.2)

2.2.1 Probe. A probe such as that described in Section 2.1.1 is suitable.

2.2.2 Condenser. An air-cooled or water-cooled condenser, or other condenser that will not remove O_2, CO_2, CO, and N_2 may be used to remove excess moisture which would interfere with the operation of the pump and flow meter.

2.2.3 Valve. A needle valve is used to adjust sample gas flow rate.

2.2.4 Pump. A leak-free, diaphragm-type pump, or equivalent, is used to transport sample gas to the flexible bag. Install a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.2.5 Rate Meter. The rotameter, or equivalent rate meter, used should be capable of measuring flow rate to within ± 2 percent of the selected flow rate. A flow rate range of 500 to 1000 cm^3/min is suggested.

2.2.6 Flexible Bag. Any leak-free plastic (e.g., Tedlar, Mylar, Teflon) or plastic-coated aluminum (e.g., aluminized Mylar) bag, or equivalent, having a capacity consistent with the selected flow rate and time length of the test run, may be used. A capacity in the range of 55 to 90 liters is suggested.

To leak-check the bag, connect it to a water manometer and pressurize the bag to 5 to 10 cm H_2O (2 to 4 in H_2O) and allow to stand overnight. A deflated bag indicates a leak.

2.2.7 Pressure Gauge. A water-filled U-tube manometer, or equivalent, of about 30 cm (12 in) is used for the flexible bag leak-check.

2.2.8 Vacuum Gauge. A mercury manometer, or equivalent, of at least 760 mm Hg (30 in Hg) is used for the sampling train leak-check.

2.3 Analysis. For Orsat and Fyrite analyzer maintenance and operation procedures, follow the instructions recommended by the manufacturer, unless otherwise specified herein.

2.2.5 Rate Meter. The rotameter, or equivalent rate meter, used should be capable of measuring flow rate to within ± 2 percent of the selected flow rate. A flow rate range of 500 to 1000 cm^3/min is suggested.

2.2.6 Flexible Bag. Any leak-free plastic (e.g., Tedlar, Mylar, Teflon) or plastic-coated aluminum (e.g., aluminized Mylar) bag, or equivalent, having a capacity consistent with the selected flow rate and time length of the test run, may be used. A capacity in the range of 55 to 90 liters is suggested.

To leak-check the bag, connect it to a water manometer and pressurize the bag to 5 to 10 cm H_2O (2 to 4 in H_2O) and allow to stand overnight. A deflated bag indicates a leak.

2.2.7 Pressure Gauge. A water-filled U-tube manometer, or equivalent, of about 30 cm (12 in) is used for the flexible bag leak-check.

2.2.8 Vacuum Gauge. A mercury manometer, or equivalent, of at least 760 mm Hg (30 in Hg) is used for the sampling train leak-check.

2.3 Analysis. For Orsat and Fyrite analyzer maintenance and operation procedures, follow the instructions recommended by the manufacturer, unless otherwise specified herein.

2.3.1 Dry Molecular Weight Determination. An Orsat analyzer or Fyrite type combustion gas analyzer may be used.

2.3.2 Emission Rate Correction Factor or Excess Air Determination. An Orsat analyzer must be used. For low CO_2 (less than 4.0 percent) or high O_2 (greater than 15.0 percent) concentrations, the measuring burette of the Orsat must have at least 0.1 percent subdivisions.

3. Dry Molecular Weight Determination

Any of the three sampling and analytical procedures described below may be used for determining the dry molecular weight.

3.1 Single-Point, Grab Sampling and Analytical Procedure

3.1.1 The sampling point in the duct shall either be at the centroid of the cross section or at a point no closer to the walls than 1.00 m (3.3 ft), unless otherwise specified by the Control Agency's Authorized Representative.

3.1.2 Set up the equipment as shown in Figure 3.1, making sure all connections ahead of the analyzer are tight and leak-free. If an Orsat analyzer is used, it is recommended that the analyzer be leak-checked by following the procedure in Section 5.

3.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer and immediately analyze it for percent CO_2 and percent O_2. Determine the percentage of the gas that is N_2 and CO by subtracting the sum of the percent CO_2 and percent O_2 from 100 percent. Calculate the dry molecular weight as indicated in Section 6.3.

3.1.4 Repeat the sampling, analysis, and calculation procedures, until the dry molecular weights of any three grab samples differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole).

Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (lb/lb-mole).

3.2 Single-Point, Integrated Sampling and Analytical Procedure

3.2.1 The sampling point in the duct shall be located as specified in Section 3.1.1.

3.2.2 Leak-check (optional) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (optional) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum should remain stable for at least 0.5 minute. Evacuate the flexible bag.

3.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer and immediately analyze it for percent CO_2 and percent O_2. Determine the percentage of the gas that is N_2 and CO by subtracting the sum of the percent CO_2 and percent O_2 from 100 percent. Calculate the dry molecular weight as indicated in Section 6.3.

3.1.4 Repeat the sampling, analysis, and calculation procedures, until the dry molecular weights of any three grab samples differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole).

Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (lb/lb-mole).

3.2 Single-Point, Integrated Sampling and Analytical Procedure

3.2.1 The sampling point in the duct shall be located as specified in Section 3.1.1.

3.2.2 Leak-check (optional) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (optional) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum should remain stable for at least 0.5 minute. Evacuate the flexible bag.

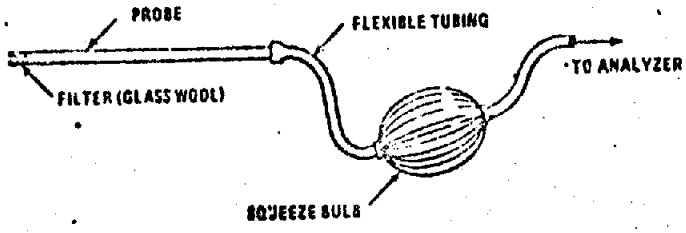

Figure 3-1. Grab-sampling train.

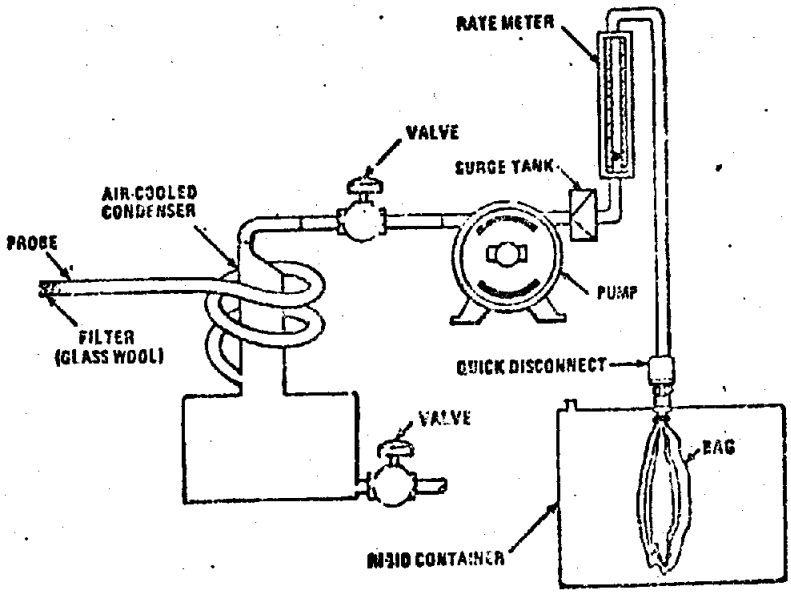

Figure 3-2. Integrated gas sampling train.

TIME	TRAVERSE PT.	Q · 1pm	% DEV.[a]
	AVERAGE		

[a] % DEV = $\left(\frac{Q - Q_{avg}}{Q_{avg}}\right) 100$ (MUST BE < 10%)

Figure 3-3. Sampling rate data.

Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak-free.

3.2.3 Sample at a constant rate. The sampling run should be simultaneous with, and for the same total length of time as, the pollutant emission rate determination. Collection of at least 30 liters (1.00 ft^3) of sample gas is recommended; however, smaller volumes may be collected, if desired.

3.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. Within 8 hours after the sample is taken, analyze it for percent CO_2 and percent O_2 using either an Orsat analyzer or a Fyrite-type combustion gas analyzer. If an Orsat analyzer is used, it is recommended that the Orsat leak-check described in Section 5 be performed before this determination; however, the check is optional. Determine the percentage of the gas that is N_2 and CO by subtracting the sum of the percent CO_2 and percent O_2 from 100 percent. Calculate the dry molecular weight as indicated in Section 6.3.

3.2.5 Repeat the analysis and calculation procedures until the individual dry molecular weights for any three analyses differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole).

Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak-free.

3.2.3 Sample at a constant rate. The sampling run should be simultaneous with, and for the same total length of time as, the pollutant emission rate determination. Collection of at least 30 liters (1.00 ft^3) of sample gas is recommended; however, smaller volumes may be collected, if desired.

3.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. Within 8 hours after the sample is taken, analyze it for percent CO_2 and percent O_2 using either an Orsat analyzer or a Fyrite-type combustion gas analyzer. If an Orsat analyzer is used, it is recommended that the Orsat leak-check described in Section 5 be performed before this determination; however, the check is optional. Determine the percentage of the gas that is N_2 and CO by subtracting the sum of the percent CO_2 and percent O_2 from 100 percent. Calculate the dry molecular weight as indicated in Section 6.3.

3.2.5 Repeat the analysis and calculation procedures until the individual dry molecular weights for any three analyses differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole).

Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (0.1 lb/lb-mole).

3.3 Multi-Point, Integrated Sampling and Analytical Procedure

3.3.1 Unless otherwise specified by the Control Agency's Authorized Representative, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in), a minimum of nine shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in), and a minimum of twelve traverse points shall be used for all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to approval of the Control Agency's Authorized Representative.

3.3.2 Follow the procedures outlined in Sections 3.2.2 through 3.2.5, except for the following; traverse all sampling points and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3.

4. Emission Rate Correction Factor or Excess Air Determination

Note: A Fyrite-type combustion gas analyzer is not acceptable for excess air or emission rate correction factor determination, unless approved by the Control Agency's Authorized Representative. If both percent CO_2 and percent O_2 are measured, the analytical results of any of the three procedures given below may also be used for calculating the dry molecular weight.

Each of the three procedures below shall be used only when specified in an applicable subpart of the standards. The use of these procedures for other purposes must have specific prior approval of the Control Agency's Authorized Representative.

4.1 Single Point, Grab Sampling and Analytical Procedure

4.1.1 The sampling point in the duct shall either be at the centroid of the cross-section or at a point no closer to the walls than 1.00 m (3.3 ft), unless otherwise specified by the administrator.

4.1.2 Set up the equipment as shown in Figure 3-1, making sure all connections ahead of the analyzer are tight and leak-free. Leak-check the Orsat analyzer according to the procedure described in Section 3. This leak-check is mandatory.

4.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer. For emission rate correction factor determination, immediately analyze the sample, as outlined in Sections 4.1.4 and 4.1.5, for percent CO_2 or percent O_2. If excess air is desired, proceed as follows: (1) immediately analyze the sample, as in Sections 4.1.4 and 4.1.5, for percent CO_2, O_2, and CO; (2) determine the percentage of the gas that is N_2 by subtracting the sum of the percent CO_2, percent O_2, and percent CO from 100

Each of the three procedures below shall be used only when specified in an applicable subpart of the standards. The use of these procedures for other purposes must have specific prior approval of the Control Agency's Authorized Representative.

4.1 Single Point, Grab Sampling and Analytical Procedure

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4.1.2 Set up the equipment as shown in Figure 3-1, making sure all connections ahead of the analyzer are tight and leak-free. Leak-check the Orsat analyzer according to the procedure described in Section 3. This leak-check is mandatory.

4.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer. For emission rate correction factor determination, immediately analyze the sample, as outlined in Sections 4.1.4 and 4.1.5, for percent CO_2 or percent O_2. If excess air is desired, proceed as follows: (1) immediately analyze the sample, as in Sections 4.1.4 and 4.1.5, for percent CO_2, O_2, and CO; (2) determine the percentage of the gas that is N_2 by subtracting the sum of the percent CO_2, percent O_2, and percent CO from 100

percent; and (3) calculate percent excess air as outlined in Section 6.2.

4.1.4 To ensure complete absorption of the CO_2, O_2, or if applicable, CO, make repeated passes through each absorbing solution until two consecutive readings are the same. Several passes (three or four) should be made between readings. (If constant readings cannot be obtained after three consecutive readings, replace the absorbing solution.)

4.1.5 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 5. For the results of the analysis to be valid, the Orsat analyzer must pass this leak test before and after the analysis. Note: Since this single-point, grab sampling and analytical procedure is normally conducted in conjunction with a single-point, grab sampling and analytical procedure for a pollutant, only one analysis is ordinarily conducted. Therefore, great care must be taken to obtain a valid sample and analysis. Although in most cases only CO_2 or O_2 is required, it is recommended that both CO_2 and O_2 be measured, and that Citation 5 in the Bibliography be used to validate the analytical data.

4.2 Single-Point, Integrated Sampling and Analytical Procedure

4.2.1 The sampling point in the duct shall be located as specified in Section 4.1.1.

4.2.2 Leak-check (mandatory) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (mandatory) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum shall remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak free.

4.2.3 Sample at a constant rate, or as specified by the Control Agency's Authorized Representative. The sampling run must be simultaneous with, and for the same total length of time as, the pollution emission rate determination. Collect at least 30 liters (1.00 ft^3) of sample gas. Smaller volumes may be collected, subject to approval of the Control Agency's Authorized Representative.

4.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. For emission rate correction factor determination, analyze the sample within 4 hours after it is taken for percent CO_2 or percent O_2 (as outlined in Sections 4.2.5 through 4.2.7). The Orsat analyzer must be leak-checked (see Section 5) before the analysis. If excess air is desired, proceed as follows: (1) within 4 hours after

4.2.2 Leak-check (mandatory) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (mandatory) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum shall remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak free.

4.2.3 Sample at a constant rate, or as specified by the Control Agency's Authorized Representative. The sampling run must be simultaneous with, and for the same total length of time as, the pollution emission rate determination. Collect at least 30 liters (1.00 ft^3) of sample gas. Smaller volumes may be collected, subject to approval of the Control Agency's Authorized Representative.

4.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. For emission rate correction factor determination, analyze the sample within 4 hours after it is taken for percent CO_2 or percent O_2 (as outlined in Sections 4.2.5 through 4.2.7). The Orsat analyzer must be leak-checked (see Section 5) before the analysis. If excess air is desired, proceed as follows: (1) within 4 hours after

the sample is taken, analyze it (as in Sections 4.2.5 through 4.2.7) for percent CO_2, O_2, and CO; (2) determine the percentage of the gas that is N_2 by subtracting the sum of the percent CO_2, percent O_2 and percent CO from 100 percent; (3) calculate percent excess air, as outlined in Section 6.2.

4.2.5 To ensure complete absorption of the CO_2, O_2, or if applicable, CO, make repeated passes through each absorbing solution until two consecutive readings are the same. Several passes (three or four) should be made between readings. (If constant readings cannot be obtained after three consecutive readings, replace the absorbing solution.)

4.2.6 Repeat the analysis until the following criteria are met:

4.2.6.1 For percent CO_2, repeat the analytical procedure until the results of any three analyses differ by no more than (a) 0.3 percent by volume when CO_2 is greater than 4.0 percent or (b) 0.2 percent by volume when CO_2 is less than or equal to 4.0 percent. Average the three acceptable values of percent CO_2 and report the results to the nearest 0.1 percent.

4.2.6.2 For percent O_2, repeat the analytical procedure until the results of any three analyses differ by no more than (a) 0.3 percent by volume when O_2 is less

than 15.0 percent or (b) 0.2 percent by volume when O_2 is greater than or equal to 15.0 percent. Average the three acceptable values of percent O_2 and report the results to the nearest 0.1 percent.

4.2.6.3 For percent CO, repeat the analytical procedure until the results of any three analyses differ by no more than 0.3 percent. Average the three acceptable values of percent CO and report the results to the nearest 0.1 percent.

4.2.7 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 5. For the results of the analysis to be valid, the Orsat analyzer must pass this leak test before and after the analysis.

Note: Although in most instances only CO_2 or O_2; is required, it is recommended that both CO_2 and O_2 be measured, and that Citation 5 in the Bibliography be used to validate the analytical data.

4.3 Multi-Point, Integrated Sampling and Analytical Procedure

4.3.1 Both the minimum number of sampling points and the sampling point location shall be as specified in Section 3.3.1 of this method. The use of fewer points than specified is subject to the approval of the Control Agency's Authorized Representative.

than 15.0 percent or (b) 0.2 percent by volume when O_2 is greater than or equal to 15.0 percent. Average the three acceptable values of percent O_2 and report the results to the nearest 0.1 percent.

4.2.6.3 For percent CO, repeat the analytical procedure until the results of any three analyses differ by no more than 0.3 percent. Average the three acceptable values of percent CO and report the results to the nearest 0.1 percent.

4.2.7 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 5. For the results of the analysis to be valid, the Orsat analyzer must pass this leak test before and after the analysis.

Note: Although in most instances only CO_2 or O_2; is required, it is recommended that both CO_2 and O_2 be measured, and that Citation 5 in the Bibliography be used to validate the analytical data.

4.3 Multi-Point, Integrated Sampling and Analytical Procedure

4.3.1 Both the minimum number of sampling points and the sampling point location shall be as specified in Section 3.3.1 of this method. The use of fewer points than specified is subject to the approval of the Control Agency's Authorized Representative.

4.3.2 Follow the procedures outlined in Section 4.2.2 through 4.2.7, except for the following: Traverse all sampling points and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3.

5. Leak-Check Procedure for Orsat Analyzers

Moving an Orsat analyzer frequently causes it to leak. Therefore, an Orsat analyzer should be thoroughly leak-checked on site before the flue gas sample is introduced into it. The procedure for leak-checking an Orsat analyzer is:

5.1.1 Bring the liquid level in each pipette up to the reference mark on the capillary tubing and then close the pipette stopcock.

5.1.2 Raise the leveling bulb sufficiently to bring the confining liquid meniscus onto the graduated portion of the burette and then close the manifold stopcock.

5.1.3 Record the meniscus position.

5.1.4 Observe the meniscus in the burette and the liquid level in the pipette for movement over the next 4 minutes.

5.1.5 For the Orsat analyzer to pass the leak-check, two conditions must be met.

5.1.5.1 The liquid level in each pipette must not fall below the bottom of the capillary tubing during this 4-minute interval.

5.1.5.2 The meniscus in the burette must not change by more than 0.2 ml during this 4-minute interval.

5.1.6 If the analyzer fails the leak-check procedure, all rubber connections and stopcocks should be checked until the cause of the leak is identified. Leaking stopcocks must be disassembled, cleaned, and regreased. Leaking rubber connections must be replaced. After the analyzer is reassembled, the leak-check procedure must be repeated.

6. Calculations

6.1 Nomenclature.

M_d	=	Dry molecular weight, g/g-mole (lb/lb-mole)
Percent EA	=	Percent excess air.
Percent CO_2	=	Percent CO_2 by volume (dry basis).
Percent O_2	=	Percent O_2 by volume (dry basis).
Percent CO	=	Percent CO by volume (dry basis).
Percent N_2	=	Percent N_2 by volume (dry basis).
0.264	=	Ratio of O_2 to N_2 in air, v/v.
0.280	=	Molecular weight of N_2 or CO, divided by 100.
0.320	=	Molecular weight of O_2 divided by 100.
0.440	=	Molecular weight of CO_2 divided by 100

5.1.5.1 The liquid level in each pipette must not fall below the bottom of the capillary tubing during this 4-minute interval.

5.1.5.2 The meniscus in the burette must not change by more than 0.2 ml during this 4-minute interval.

5.1.6 If the analyzer fails the leak-check procedure, all rubber connections and stopcocks should be checked until the cause of the leak is identified. Leaking stopcocks must be disassembled, cleaned, and regreased. Leaking rubber connections must be replaced. After the analyzer is reassembled, the leak-check procedure must be repeated.

6. Calculations

6.1 Nomenclature.

M_d	=	Dry molecular weight, g/g-mole (lb/lb-mole)
Percent EA	=	Percent excess air.
Percent CO_2	=	Percent CO_2 by volume (dry basis).
Percent O_2	=	Percent O_2 by volume (dry basis).
Percent CO	=	Percent CO by volume (dry basis).
Percent N_2	=	Percent N_2 by volume (dry basis).
0.264	=	Ratio of O_2 to N_2 in air, v/v.
0.280	=	Molecular weight of N_2 or CO, divided by 100.
0.320	=	Molecular weight of O_2 divided by 100.
0.440	=	Molecular weight of CO_2 divided by 100

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent O_2, CO, and N_2 (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

$$\text{percent EA} = \left[\frac{\text{percent } O_2 - 0.5 \text{ percent CO}}{0.264 \text{ percent } N_2 - \text{percent } O_2 + 0.5 \text{ percent CO}}\right] 100$$

Equation 3-1

Note: The equation above assumes that ambient air is used as the source of O_2 and that the fuel does not contain appreciable amounts of N_2 (as do coke or blast furnace gases). For those cases when appreciable amounts of N_2 are present (coal, oil, and natural gas do not contain appreciable amounts of N_2) or when oxygen enrichment is used, alternate methods, subject to approval of the Control Agency's Authorized Representative, are required.

6.3 Dry Molecular Weight. Use Equation 3-2 to calculate the dry molecular weight of the stack gas.

$$M_d = 0.440 \text{ (percent } CO_2) + 0.320 \text{ (percent } O_2) + 0.280 \text{ (percent } N_2 + \text{percent CO)}$$

Equation 3-2

Note: The above equation does not consider argon in air (about 0.9 percent, molecular weight of 37.7). A negative error of about 0.4 percent is introduced. The tester may opt to include argon in the analysis using procedures subject to approval of the Control Agency's Authorized Representative.

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METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

1. Principle and Applicability

1.1 Principle: A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined either volumetrically or gravimetrically.

1.2 Applicability: This method is applicable for determining the moisture content of stack gas.

Two procedures are given. The first is a reference method, for accurate determinations of moisture content (such as are needed to calculate emission data). The second is an approximation method, which provides estimates of percent moisture to aid in setting isokinetic sampling rates prior to a pollutant emission measurement run. The approximation method described herein is only a suggested approach; alternative means for approximating the moisture content, e.g., drying tubes, wet bulb-dry bulb techniques, condensation techniques, stoichiometric calculations, previous experience, etc., are also acceptable.

The reference method is often conducted simultaneously with a pollutant emission measurement run; when it is, calculation of percent isokinetic,

pollutant emission rate, etc., for the run shall be based upon the results of the reference method or its equivalent; these calculations shall not be based upon results of the approximation method, unless the approximation method is shown, to the satisfaction of the Control Agency's Authorized Representative, to be capable of yielding results within 1 percent H_2O of the reference method.

Note - The reference method may yield questionable results when applied to saturated gas streams or to streams that contain water droplets. Therefore, when these conditions exist or are suspected, a second determination of the moisture content shall be made simultaneously with the reference method, as follows: Assume that the gas stream is saturated. Attach a temperature sensor [capable of measuring to $\pm$ 1°C (2°F)] to the reference method probe. Measure the stack gas temperature at each traverse point (see Section 2.2.1) during the reference method traverse; calculate the average stack gas temperature. Next, determine the moisture percentage, either by: (1) using a psychrometric chart and making appropriate

pollutant emission rate, etc., for the run shall be based upon the results of the reference method or its equivalent; these calculations shall not be based upon results of the approximation method, unless the approximation method is shown, to the satisfaction of the Control Agency's Authorized Representative, to be capable of yielding results within 1 percent H_2O of the reference method.

Note - The reference method may yield questionable results when applied to saturated gas streams or to streams that contain water droplets. Therefore, when these conditions exist or are suspected, a second determination of the moisture content shall be made simultaneously with the reference method, as follows: Assume that the gas stream is saturated. Attach a temperature sensor [capable of measuring to $\pm$ 1°C (2°F)] to the reference method probe. Measure the stack gas temperature at each traverse point (see Section 2.2.1) during the reference method traverse; calculate the average stack gas temperature. Next, determine the moisture percentage, either by: (1) using a psychrometric chart and making appropriate

corrections if stack pressure is different from that of the chart, or (2) using saturation vapor pressure tables. In cases where the psychrometric chart or the saturation vapor pressure tables are not applicable (based on evaluation of the process), alternate methods, subject to the approval of the Control Agency's Authorized Representative, shall be used.

2. Reference Method

The procedure described in Method 5 for determining moisture content is acceptable as a reference method.

2.1 Apparatus

A schematic of the sampling train used in this reference method is shown in Figure 4-1. All components shall be maintained and calibrated according to the procedure outlined in Method 5.

2.1.1 Probe. The probe is constructed of stainless steel or glass tubing, sufficiently heated to prevent water condensation, and is equipped with a filter either in-stack (e.g., a plug of glass wool inserted into the end of the probe) or heated out-stack (e.g., as described in Method 5) to remove particulate matter.

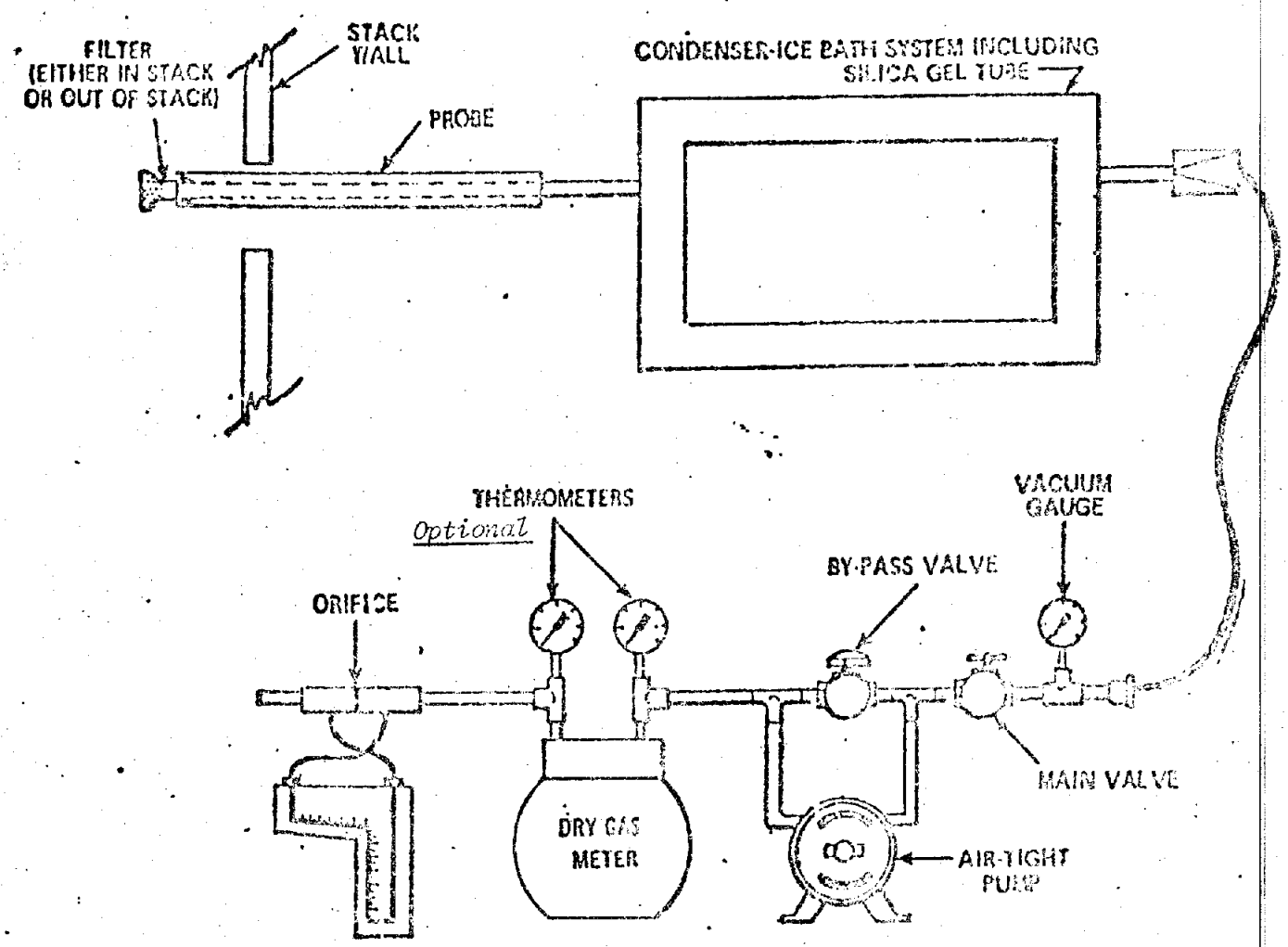

Figure 4-1. Moisture sampling train.

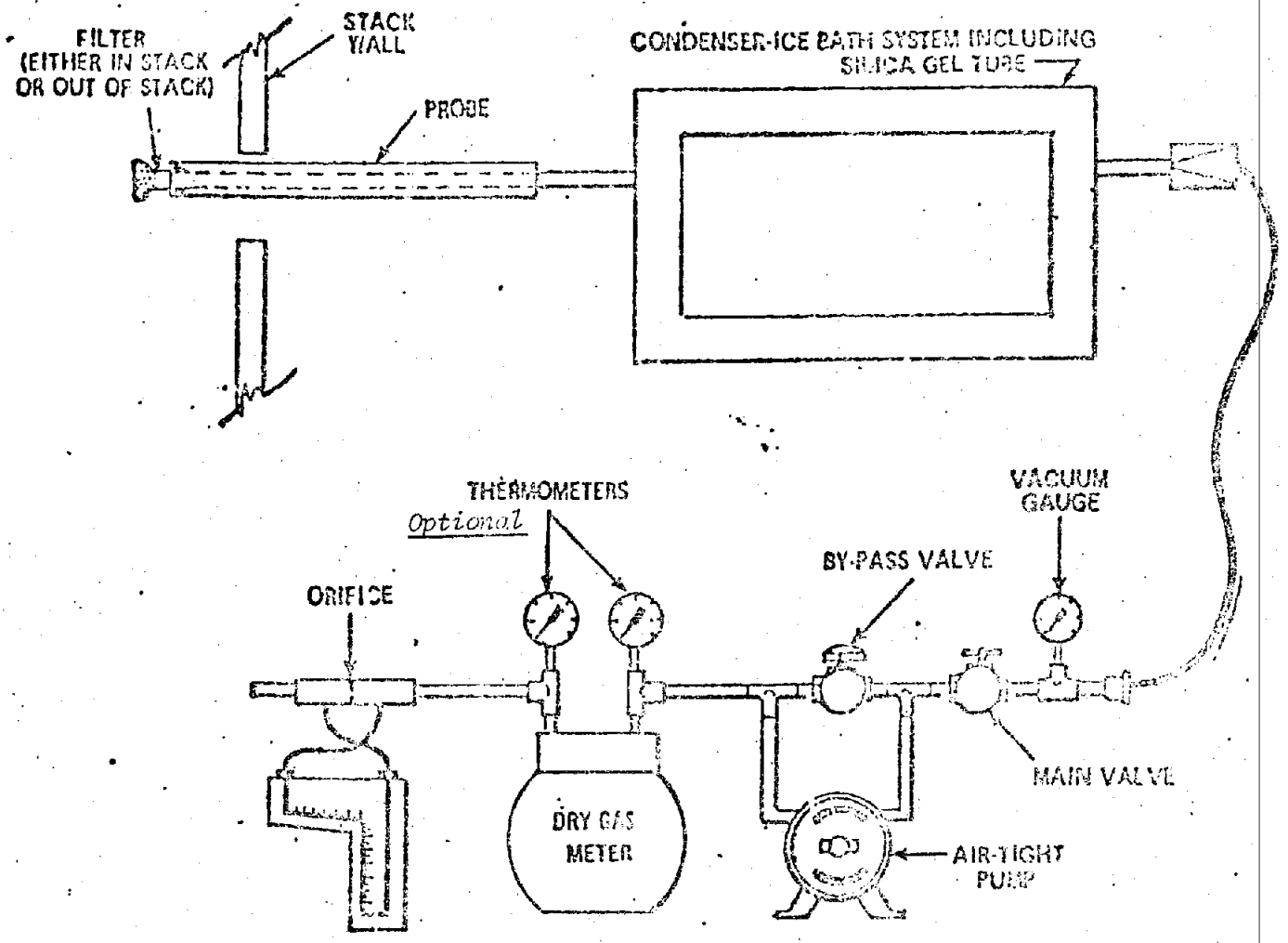

Figure 4-1. Moisture sampling train.

When stack conditions permit, other metals or plastic tubing may be used for the probe, subject to the approval of the Control Agency's Authorized Representative.

2.1.2 Condenser. The condenser consists of four impingers connected in series with ground glass, leak-free fittings or any similarly leak-free non-contaminating fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3 centimeter (1/2 inch) ID glass tube extending to about 1.3 cm (1/2 in.) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. Modifications (e.g., using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the condenser) may be used, subject to the approval of the Control Agency's Authorized Representative.

The first two impingers shall contain known volumes of water, the third shall be empty, and the fourth shall contain a known weight of 6 to 16 mesh indicating type silica gel, or equivalent desiccant. If the silica gel has been previously used, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. A thermometer, capable of measuring temperature to within 1°C (2°F), shall be placed at the outlet of the fourth impinger, for monitoring purposes.

Alternatively, any system may be used (subject to the approval of the Control Agency's Authorized Representative) that cools the sample gas stream and allows measurement of both the water that has been condensed and the moisture leaving the condenser, each to within 1 ml or 1 g. Acceptable means are to measure the condensed water, either gravimetrically or volumetrically, and to measure the moisture leaving the condenser by: (1) monitoring the temperature and pressure at the exit of the condenser and using Dalton's law of partial pressures, or (2) passing the sample gas stream through a tared silica gel (or equivalent desiccant) trap, with exit gases kept below 20°C (68°F), and determining the weight gain.

If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel (or equivalent) still be used between the condenser system and pump, to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

2.1.3 Cooling System. An ice bath container and crushed ice (or equivalent) are used to aid in condensing moisture.

2.1.4 Metering System. This system includes a vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter capable of measuring

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If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel (or equivalent) still be used between the condenser system and pump, to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

2.1.3 Cooling System. An ice bath container and crushed ice (or equivalent) are used to aid in condensing moisture.

2.1.4 Metering System. This system includes a vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter capable of measuring

volume to within 2 percent, and related equipment as shown in Figure 4-1. Other metering systems, capable of maintaining a constant sampling rate and determining sample gas volume, may be used, subject to the approval of the Control Agency's Authorized Representative.

2.1.5 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) may be used. In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.6 Graduated Cylinder and/or Balance. These items are used to measure condensed water and moisture caught in the silica gel to within 1 ml or 0.5 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. These balances are suitable for use here.

2.2 Procedure. The following procedure is written for a condenser system (such as the impinger system described in Section 2.1.2) incorporating volumetric analysis to measure the condensed moisture,

and silica gel and gravimetric analysis to measure the moisture leaving the condenser.

2.2.1 Unless otherwise specified by the Control Agency's Authorized Representative, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in), a minimum of nine points shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in), and a minimum of twelve traverse points shall be used in all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to the approval of the Control Agency's Authorized Representative. Select a suitable probe and probe length such that all traverse points can be sampled. Consider sampling from opposite sides of the stack (four total sampling ports) for large stacks, to permit use of shorter probe lengths. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Place known volumes of water in the first two impingers. Weigh and record the weight of the silica gel to the nearest 0.5 g, and transfer the silica gel to the fourth impinger; alternatively, the silica gel may first be transferred to the impinger, and the weight of the silica gel plus impinger recorded.

2.2.2 Select a total sampling time such that a minimum total gas volume of 0.60 scm (21 scf) will be collected, at a rate no

and silica gel and gravimetric analysis to measure the moisture leaving the condenser.

2.2.1 Unless otherwise specified by the Control Agency's Authorized Representative, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in), a minimum of nine points shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in), and a minimum of twelve traverse points shall be used in all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to the approval of the Control Agency's Authorized Representative. Select a suitable probe and probe length such that all traverse points can be sampled. Consider sampling from opposite sides of the stack (four total sampling ports) for large stacks, to permit use of shorter probe lengths. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Place known volumes of water in the first two impingers. Weigh and record the weight of the silica gel to the nearest 0.5 g, and transfer the silica gel to the fourth impinger; alternatively, the silica gel may first be transferred to the impinger, and the weight of the silica gel plus impinger recorded.

2.2.2 Select a total sampling time such that a minimum total gas volume of 0.60 scm (21 scf) will be collected, at a rate no

greater than 0.021 m^3/min (0.75 cfm). When both moisture content and pollutant emission rate are to be determined, the moisture determination shall be simultaneous with, and for the same total length of time as, the pollutant emission rate run, unless otherwise specified in an applicable subpart of the standards.

2.2.3 Set up the sampling train as shown in Figure 4-1. Turn on the probe heater and (if applicable) the filter heating system to temperatures of about 120°C (248°F), to prevent water condensation ahead of the condenser; allow time for the temperature to stabilize. Place crushed ice in the ice bath container. It is required that a leak check be performed before and after each test as follows: Disconnect the probe from the first impinger or (if applicable) from the filter holder. Plug the inlet to the first impinger (or filter holder) and pull a 380 mm (15 in) Hg vacuum; a lower vacuum may be used, provided that it is not exceeded during the test. A leakage rate in excess of 4 percent of the average sampling rate or 0.00057 m^3/min (0.02 cfm), whichever is less, is unacceptable. Following the leak check, reconnect the probe to the sampling train.

2.2.4 During the sampling run, maintain a sampling rate within 10 percent of constant rate, or as specified by the Control Agency's Authorized Representative. For each run, record the

FIGURE 4.2

Example Data Sheet for Moisture Determination

State of California

AIR RESOURCES BOARD

WATER VAPOR CALCULATIONS

Standard Conditions 68°F and 29.92 in. Hg

Ambient Condtions ___°F and _____ in. Hg

Time	Gas Volume Through Meter (V_m), Ft^3	Impinger Temp. (T_i), °F	Meter Temp. (T_m), °F	Orifice Pressure (ΔH), in. H_2O	Volume of Water Collected in Impingers (V_{l_c}), ml
					Final
					Initial
					Net (V_{l_c})

Assume 1 gram $H_2O \approx 1$ ml H_2O

A. Gas Volume Metered ($V_{m\text{-}std}$)

$$P_{bar} = P_{bar} + (\Delta H/13.6) = (\quad) + \frac{(\quad)}{13.6} = \_\_\_\_\_ \text{ in. Hg}$$

$$V_{m\text{-}std} = \frac{528\ °R}{29.92 \text{ in. Hg}} \times \frac{V_m P_{bar}}{T_m} = (17.64)\ \frac{(\quad)(\quad)}{(\quad)} = \_\_\_\_\_ \text{ SCF}$$

B. Volume of Water Collected ($V_{w\text{-}std}$)

$$V_{w\text{-}std} = (0.04707\ \frac{Ft^3}{ml})\ (V_{l_c}) = (0.04707)\ (\quad) = \_\_\_\_\_ \text{ SCF}$$

C. Moisture Content in Stack Gas (Bw) in Percent

$$Bw = \frac{B}{A + B} \times 100 = \frac{(\quad)}{(\quad)} \times 100 = \_\_\_\_\_$$

D. If calculated moisture content (c) is greater than at saturation temperature (e.g. 212°F or below) use the table for moisture content.

% OF H_2O AT SATURATION

TEMP. °F	% H_2O	TEMP. °F	% H_2O	TEMP. °F	% H_2O
50	1.2	130	15.1	180	51.1
60	1.7	140	19.7	185	57.0
70	2.5	150	25.5	190	63.0
80	3.5	155	28.7	195	70.4
90	4.8	160	32.5	200	76.6
100	6.5	165	36.4	205	87.0
110	8.7	170	40.3	210	95.2
120	11.5	175	45.7	212	100.0

FIGURE 4.2

Example Data Sheet for Moisture Determination

State of California

AIR RESOURCES BOARD

WATER VAPOR CALCULATIONS

Standard Conditions 68°F and 29.92 in. Hg

Ambient Condtions ___°F and _____ in. Hg

Time	Gas Volume Through Meter (V_m), Ft^3	Impinger Temp. (T_i), °F	Meter Temp. (T_m), °F	Orifice Pressure (Δh), in. H_2O	Volume of Water Collected in Impinger (V_{l_c}), ml
					Final
					Initial
					Net (V_{l_c})

Assume 1 gram $H_2O \approx 1$ ml H_2O

A. Gas Volume Metered (V_{mstd})

$$P_{bm} = P_{bar} + (\Delta H/13.6) = (\quad) + \frac{(\quad)}{13.6} = \_\_\_\_\_ \text{ in. Hg}$$

$$V_{mstd} = \frac{528\ ^\circ R}{29.92 \text{ in. Hg}} \times \frac{V_m P_{bm}}{T_m} = (17.64)\ \frac{(\quad)(\quad)}{(\quad)} = \_\_\_\_\_ \text{ SCF}$$

B. Volume of Water Collected (V_{wstd})

$$V_{wstd} = (0.04707\ \frac{Ft^3}{ml})\ (V_{l_c}) = (0.04707)\ (\quad) = \_\_\_\_\_ \text{ SCF}$$

C. Moisture Content in Stack Gas (Bw) in Percent

$$Bw = \frac{B}{A + B} \times 100 = \frac{(\quad)}{(\quad)} \times 100 = \_\_\_\_\_$$

D. If calculated moisture content (C) is greater than at saturation temperature (e.g. 212°F or below) use the table for moisture content.

% OF H_2O AT SATURATION

TEMP. °F	% H_2O	TEMP. °F	% H_2O	TEMP. °F	% H_2O
50	1.2	130	15.1	180	51.1
60	1.7	140	19.7	185	57.0
70	2.5	150	25.5	190	63.6
80	3.5	155	28.7	195	70.4
90	4.8	160	32.5	200	78.8
100	6.5	165	36.4	205	87.0
110	8.7	170	40.3	210	93.2
120	11.5	175	45.7	212	100.0

data required on the example data sheet shown in Figure 4-2. Be sure to record the dry gas meter reading at the beginning and end of each sampling time increment and whenever sampling is halted. Take other appropriate readings at each sample point, at least once during each time increment.

2.2.5 To begin sampling, position the probe tip at the first traverse point. Immediately start the pump and adjust the flow to the desired rate. Traverse the cross section, sampling at each traverse point for an equal length of time. Add more ice and, if necessary, salt to maintain a temperature of less than 20°C (68°F) at the silica gel outlet.

2.2.6 After collecting the sample, disconnect the probe from the filter holder (or from the first impinger) and conduct a leak check (mandatory) as described in Section 2.2.3. Record the leak rate. If the leakage rate exceeds the allowable rate, the tester shall either reject the test results or shall correct the sample volume as in Section 6.3 of Method 5. Next, measure the volume of the moisture condensed to the nearest ml. Determine the increase in weight of the silica gel (or silica gel plus impinger) to the nearest 0.5 g. Record this information and calculate the moisture percentage, as described in 2.3 below.

2.3 Calculations. Carry out the following calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

2.3.1 Nomenclature.

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

M_w = Molecular weight of water, 18.0 g/g mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg)

R = Ideal gas constant, 0.06236 (mm Hg) (m^3)/(g-mole) (K^o) for metric units and 21.85 (in Hg) (ft^3)/(lb-mole) (^oR) for English units.

T_m = Absolute temperature at meter. ^oK (^oR).

T_{std} = Standard absolute temperature, 293° K (528°R).

V_m = Dry gas volume measured by the dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel plus impinger, g.

2.3 Calculations. Carry out the following calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

2.3.1 Nomenclature.

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

M_w = Molecular weight of water, 18.0 g/g mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg)

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T_m = Absolute temperature at meter. ^oK (^oR).

T_{std} = Standard absolute temperature, 293° K (528°R).

V_m = Dry gas volume measured by the dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel plus impinger, g.

W_i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

P_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of water vapor condensed.

$$V_{wc(std)} = \frac{(V_f - V_i)\, p_w\, RT_{std}}{P_{std}\, M_w}$$

$$= K_1 (V_f - V_i)$$

Equation 4-1

where: K_1 = 0.001333 m^3/ml for metric units

= 0.04707 ft^3/ml for English units

2.3.3 Volume of water vapor collected in silica gel.

$$V_{wsg(std)} = \frac{(W_f - W_i)\, RT_{std}}{P_{std}\, M_w}$$

$$= K_2 (W_f - W_i)$$

Equation 4-2

where: K_2 = 0.001335 m^3/g for metric units

= 0.04715 ft^3/g for English units

2.3.4 Sample gas volume.

$$V_{m(std)} = V_m\, Y\, \frac{(P_m)\, (T_{std})}{(P_{std})\, (T_m)}$$

$$= K_3 Y \left(\frac{V_m P_m}{T_m}\right)$$

Equation 4-3

where: K_3 = 0.3858 °K/mm Hg for metric units

17.65 °R/in. Hg for English units

NOTE: If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of V_m in Equation 4-3 as described in Section 6.3 of Method 5.

2.3.5 Moisture Content

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Equation 4-4

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2); and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

2.3.6 Verification of constant sampling rate. For each time increment, determine the ΔV_m. Calculate the average. If the value for any time increment differs from the average by more than 10 percent, reject the results and repeat the run.

3. Approximation Method

The approximation method described below is presented only as a suggested method (see Section 1.2).

3.1 Apparatus

3.1.1 Probe. Stainless steel or glass tubing, sufficiently heated to prevent water condensation and equipped with a filter (either in-stack or heated out-stack) to remove particulate matter. A plug of glass wool, inserted into the end of the probe, is a satisfactory filter.

2.3.5 Moisture Content

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Equation 4-4

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2); and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

2.3.6 Verification of constant sampling rate. For each time increment, determine the ΔV_m. Calculate the average. If the value for any time increment differs from the average by more than 10 percent, reject the results and repeat the run.

3. Approximation Method

The approximation method described below is presented only as a suggested method (see Section 1.2).

3.1 Apparatus

3.1.1 Probe. Stainless steel or glass tubing, sufficiently heated to prevent water condensation and equipped with a filter (either in-stack or heated out-stack) to remove particulate matter. A plug of glass wool, inserted into the end of the probe, is a satisfactory filter.

3.1.2 Impingers. Two midget impingers, each with 30 ml. capacity, or equivalent.

3.1.3 Ice Bath. Container and ice, to aid in condensing moisture in impingers.

3.1.4 Drying Tube. Tube packed with new or regenerated 6-to 16-mesh indicating-type silica gel (or equivalent desiccant), to dry the sample gas and to protect the meter and pump.

3.1.5 Valve. Needle valve, to regulate the sample gas flow rate.

3.1.6 Pump. Leak-free, diaphragm type, or equivalent to pull the gas sample through the train.

3.1.7 Volume meter. Dry gas meter, sufficiently accurate to measure the sample volume within 2 percent and calibrated over the range of flow rates and conditions actually encountered during sampling.

3.1.8 Rate Meter. Rotameter to measure the flow range from 0 to 3 lpm (0 to 0.11 cfm).

3.1.9 Graduated cylinder, 25 ml.

3.1.10 Barometer. Mercury, aneroid, or other barometer, as described in Section 2.1.5. above.

3.1.11 Vacuum Gauge. At least 760 mm Hg (30 in. Hg) gauge, to be used for the sampling leak check.

3.2 Procedure

3.2.1 Place exactly 5 ml distilled water in each impinger. Leak-check the sampling train as follows: Temporarily insert a vacuum gauge at or near the probe inlet; then, plug the probe inlet and pull a vacuum of at least 250 mm Hg (10 in

Hg). Note the time rate of change of the dry gas meter dial; alternatively, a rotameter (0-40 cc/min.) may be temporarily attached to the dry gas meter outlet to determine the leakage rate. A leak rate not in excess of 2 percent of the average sampling rate is acceptable.

Note - Carefully release the probe inlet plug before turning off the pump.

3.2.2 Connect the probe, insert it into the stack, and sample at a constant rate of 2 lpm (0.071 cfm). Continue sampling until the dry gas meter registers about 30 liters (1.1 ft^3) or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure, and dry gas meter readings as required by Figure 4-4.

3.2.3 After collecting the sample, combine the contents of the two impingers and measure the volume to the nearest 0.5 ml.

3.3 Calculations. The calculation method presented is designed to estimate the moisture in the stack gas; therefore, other data, which are only necessary for accurate moisture determinations, are not collected. The following equations adequately estimate the moisture content, for the purpose of determining isokinetic sampling rate settings.

Hg). Note the time rate of change of the dry gas meter dial; alternatively, a rotameter (0-40 cc/min.) may be temporarily attached to the dry gas meter outlet to determine the leakage rate. A leak rate not in excess of 2 percent of the average sampling rate is acceptable.

Note - Carefully release the probe inlet plug before turning off the pump.

3.2.2 Connect the probe, insert it into the stack, and sample at a constant rate of 2 lpm (0.071 cfm). Continue sampling until the dry gas meter registers about 30 liters (1.1 ft^3) or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure, and dry gas meter readings as required by Figure 4-4.

3.2.3 After collecting the sample, combine the contents of the two impingers and measure the volume to the nearest 0.5 ml.

3.3 Calculations. The calculation method presented is designed to estimate the moisture in the stack gas; therefore, other data, which are only necessary for accurate moisture determinations, are not collected. The following equations adequately estimate the moisture content, for the purpose of determining isokinetic sampling rate settings.

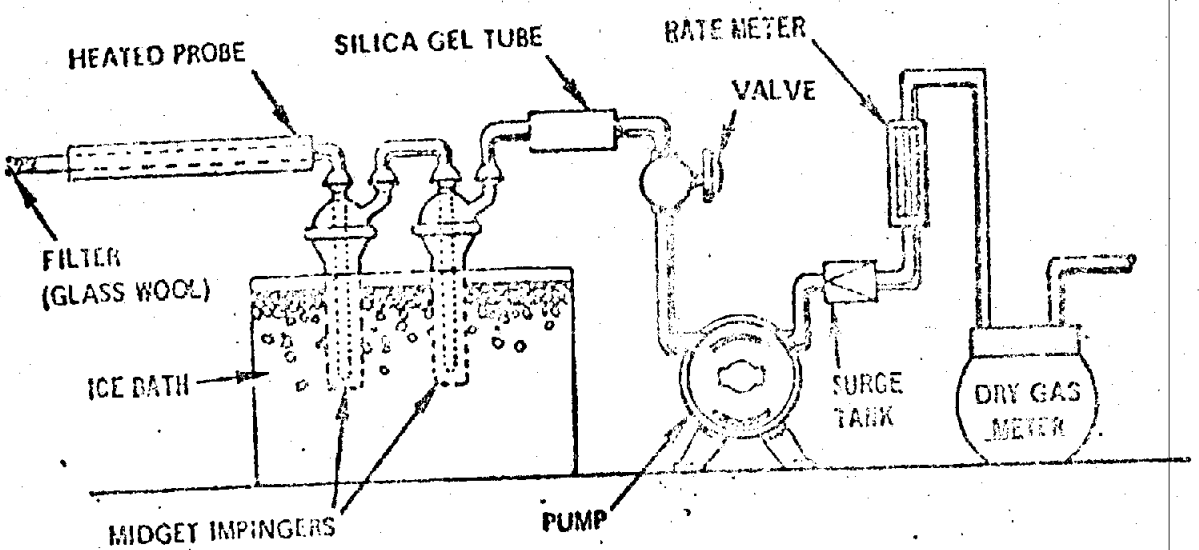

Figure 4-3. Moisture-sampling train - approximation method.

LOCATION _____ COMMENTS

TEST _____

DATE _____

OPERATOR _____

BAROMETRIC PRESSURE _____

CLOCK TIME	GAS VOLUME THROUGH METER, (Vm), m^3 (ft^3)	RATE METER SETTING m^3/min. (ft^3/min.)	METER TEMPERATURE, °C (°F)

Figure 4-4. Field moisture determination - approximation method.

3.3.1 Nomenclature.

B_{wm} = Approximate proportion, by volume, of water vapor in the gas stream leaving the second impinger, 0.025.

B_{ws} = Water vapor in the gas stream, proportion by volume.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter.

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).

R = Ideal gas constant, 0.06236 (mm Hg) $(m^3)/(g\text{-mole})$ (^oK) for metric units and 21.85 (in Hg) $(ft^3)/lb\text{-mole}$ (^oR) for English units

T_m = Absolute temperature at meter, ^{0} (^oR).

T_{std} = Standard absolute temperature, 293^oK (528^oR).

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents, ml.

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed, corrected to standard conditions, scm (scf).

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

Y = Dry gas meter calibration factor.

3.3.1 Nomenclature.

B_{wm} = Approximate proportion, by volume, of water vapor in the gas stream leaving the second impinger, 0.025.

B_{ws} = Water vapor in the gas stream, proportion by volume.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter.

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).

R = Ideal gas constant, 0.06236 (mm Hg) $(m^3)/(g\text{-mole})$ (^oK) for metric units and 21.85 (in Hg) $(ft^3)/lb\text{-mole}$ (^oR) for English units

T_m = Absolute temperature at meter, ^{0} (^oR).

T_{std} = Standard absolute temperature, 293^oK (528^oR).

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents, ml.

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed, corrected to standard conditions, scm (scf).

P_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

Y = Dry gas meter calibration factor.

3.3.2 Volume of water vapor collected.

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w RT_{(std)}}{P_{std} M_w}$$

$$= K_1 (V_f - V_i)$$

Equation 4-5

where: K_1 = 0.001333 m^3/ml for metric units

= 0.04707 ft^3/ml for English units

3.3.3 Gas Volume

$$V_m (std) = V_m \left(\frac{P_m}{P_{std}}\right) \left(\frac{T_{std}}{T_m}\right)$$

$$= K_2 Y \frac{V_m P_m}{T_m}$$

Equation 4-6

where: K_2 = 0.3858 ^oK/mm Hg for metric units

= 17.64 ^oR/in. Hg for English units

3.3.4 Approximate moisture content.

$$B_{ws} = \frac{V_{wc}}{V_{wc(std)} + V_{m(std)}} + B_{wm}$$

$$= \frac{V_{wc}}{V_{wc(std)} + V_{m(std)}} + (0.025)$$

Equation 4-7

4. Calibration

4.1 For the reference method, calibrate equipment as specified in the following sections of Method 5; Section 5-3 (metering system); Section 5.5 (temperature gauges); and Section 5.7 (barometer). The recommended leak check of the metering system (Section 5.6 of Method 5) also applies to the reference method. For the

5. Bibliography

1. Air Pollution Engineering Manual (Second Edition). Danielson, J.A. (ed.). U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. Publication No. AP-40. 1973.

2. Devorkin, Howard, et al. Air Pollution Source Testing Manual. Air Pollution Control District, Los Angeles, CA. November 1963.

3. Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases. Western Precipitation Division of Joy Manufacturing Co., Los Angeles, CA. Bulletin WP-50. 1968.

METHOD 5 - DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle: Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter maintained at a temperature in the range of 120 ± 14°C (248 ± 25°F) or such other temperature as specified by an applicable subpart of the standards or approved by the Control Agency's Authorized Representative for a particulate application. The particular mass, which includes any material that condenses at or above the filtration temperature, is determined gravimetrically after removal of uncombined water.

Since the definition of particulate matter is not consistent in all rules, the particulate matter catch should be itemized by weight as follows: (1) Filter Catch, (2) Probe Catch, (3) Impinger Catch, and (4) Solvent Extract to allow adjustment of the particulate matter determination to be consistent with the applicable regulation.

1.2 Applicability: This method is applicable for the determination of particulate emissions from stationary sources.

2. Apparatus

2.1 Sampling Train. A schematic of the sampling train used in this method is shown in Figure 5-1. Complete construction details are given in APTD-0581 (Citation 2 in Section 7); commercial models of this train are also available. For changes from APTD-0581 and for allowable modifications of the train shown in Figure 5-1, see the following subsections.

The operating and maintenance procedures for the sampling train are described in APTD-0576 (Citation 3 in Section 7). Since correct usage is important in obtaining valid results, all users should read APTD-0576 and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. The sampling train consists of the following components:

2.1.1 Probe Nozzle. Stainless steel (316) or glass with sharp, tapered leading edge. The angle of taper shall be $\leq 30^{o}$ and the taper shall be on the outside to preserve a constant internal diameter. The probe nozzle shall be of the button-hook or elbow design, unless otherwise specified by the Control Agency's Authorized Representative. If made of stainless steel, the nozzle shall be constructed from seamless tubing; other materials of construction may be used, subject to the approval of the Control Agency's Authorized Representative.

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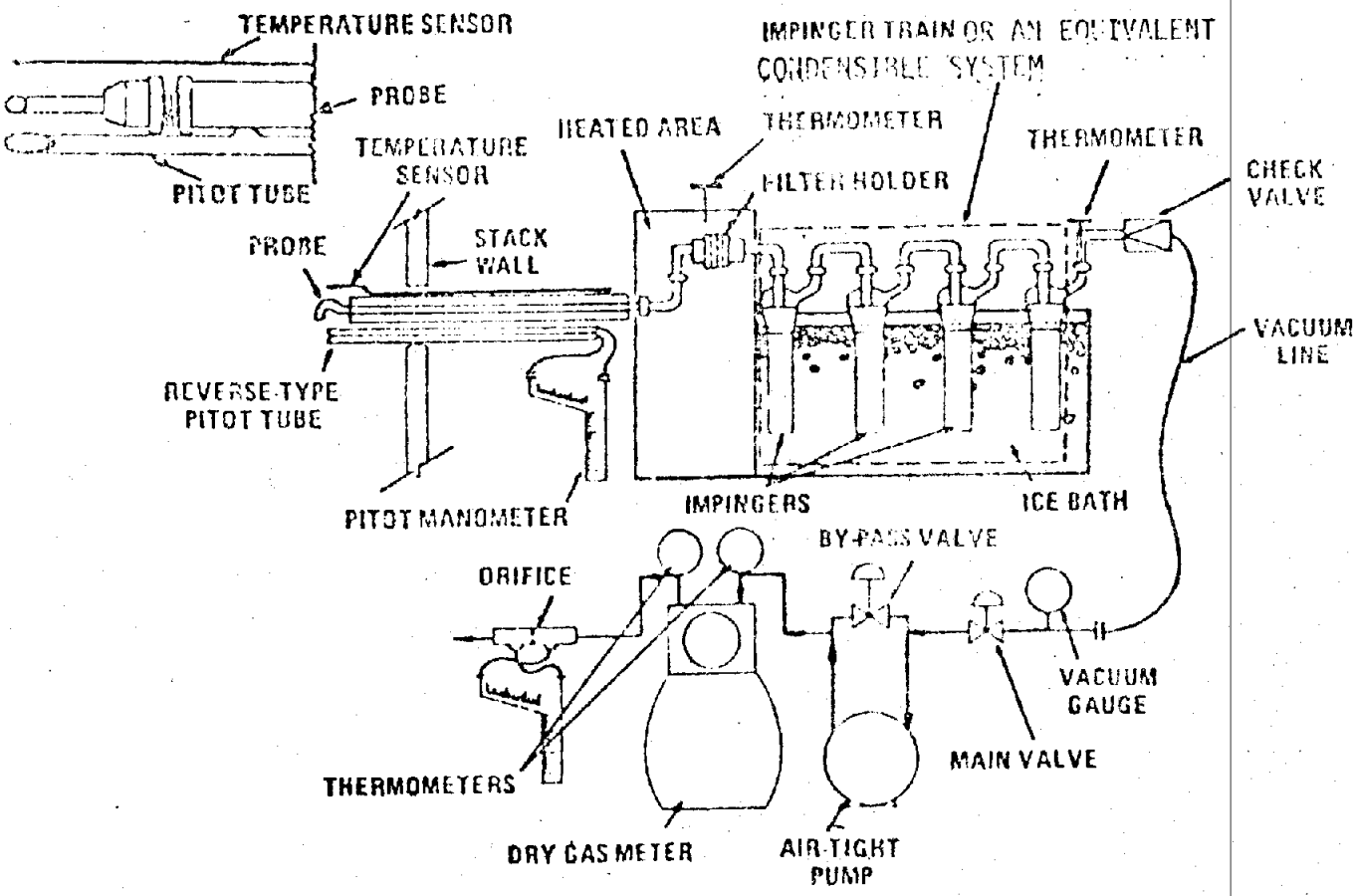

Figure 5-1 Particulate Sampling Train

A range of nozzle sizes suitable for isokinetic sampling should be available, e.g., 0.32 to 1.27 cm (1/8 to 1/2 in.) or larger if higher volume sampling trains are used inside diameter (ID) nozzles in increments of 0.16 cm (1/16 in). Each nozzle shall be calibrated according to the procedures outlined in Section 5.

2.1.2 Probe Liner. Borosilicate or quartz glass tubing with a heating system capable of maintaining a gas temperature at the exit end during sampling of 120±14°C (248±25°F), or such other temperature as specified by an applicable subpart of the standards or approved by the Control Agency's Authorized Representative for a particular application. (The tester may opt to operate the equipment at a temperature lower than that specified.) Since the actual temperature at the outlet of the probe is not usually monitored during sampling, probes constructed according to APTD-0581 and utilizing the calibration curves of APTD-0576 (or calibrated according to the procedure outlined in APTD-0576) will be considered acceptable.

Either borosilicate or quartz glass probe liners may be used for stack temperatures up to about 480°C (900°F); quartz liners shall be used for temperatures between 480

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Either borosilicate or quartz glass probe liners may be used for stack temperatures up to about 480°C (900°F); quartz liners shall be used for temperatures between 480

and 900°C (900 and 1,650°F). Both types of liners may be used at higher temperatures than specified for short periods of time, subject to the approval of the Control Agency's Authorized Representative. The softening temperature for borosilicate is 820°C (1,508°F), and for quartz it is 1,500°C (2,732°F).

Whenever practical, every effort should be made to use borosilicate or quartz glass probe liners. Alternatively, metal liners (e.g., 316 stainless steel, Incoloy 825,[1/] or other corrosion resistant metals) made of seamless tubing may be used, subject to the approval of the Control Agency's Authorized Representative.

2.1.3 Pitot Tube. Type S, as described in Section 2.1 of Method 2, or other device approved by the Control Agency's Authorized Representative. The pitot tube shall be attached to the probe (as shown in Figure 5-1) to allow constant monitoring of the stack gas velocity. The impact (high pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see Method 2, Figure 2-6b) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Section 4 of Method 2.

1/ Mention of trade names or specific products does not constitute endorsement by the Air Resources Board.

2.1.4 Differential Pressure Gauge. Inclined manometer or equivalent device (two), as described in Section 2.2 of Method 2. One manometer shall be used for velocity head (P) readings, and the other, for orifice differential pressure readings.

2.1.5 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other materials of construction (e.g. stainless steel, Teflon, Viton) may be used, subject to approval of the Control Agency's Authorized Representative. The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached immediately at the outlet of the probe (or cyclone, if used).

2.1.6 Filter Heating System. Any heating system capable of maintaining a temperature around the filter holder during sampling of 120 $\pm$ 14°C (248 $\pm$ 25°F), or such other temperature as specified by an applicable subpart of the standards or approved by the Control Agency's Authorized Representative for a particular application. Alternatively, the tester may opt to operate the equipment at a temperature lower than that specified. A temperature gauge capable of measuring temperature to within 3°C

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Alternatively, the tester may opt to operate the equipment at a temperature lower than that specified. A temperature gauge capable of measuring temperature to within 3°C

(5.4°F) shall be installed so that the temperature around the filter holder can be regulated and monitored during sampling. Heating systems other than the one shown in APTD-0581 may be used.

2.1.7 Impinger train. The following system shall be used to determine the stack gas moisture content and condensibles: Four impingers connected in series with leak-free ground glass fittings or any similar leak-free non-contaminating fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with 1.3 cm (1/2 in) ID glass tube extending to about 1.3 cm (1/2 in) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. Modifications (e.g., using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the impinger train) may be used, subject ot the approval of the Control Agency's Authorized Representative. The first and second impingers shall contain known quantities of water (Section 4.1.3), the third shall be empty, and the fourth shall contain a known weight of silica gel, or equivalent desiccant. A thermometer, capable of measuring temperature to within 1°C (2°F) shall be placed at the outlet of the fourth impinger for monitoring purposes.

Alternatively, any system that cools the sample gas stream and allows measurement of the water condensed and moisture leaving the impinger train, each to within 1 ml or 1 g may be used, subject to the approval of the Control Agency's Authorized Representative. Acceptable means are to measure the condensed water either gravimetrical or volumetrically and to measure the moisture leaving the impinger train by: (1) monitoring the temperature and pressure at the exit of the impinger train and using Dalton's law of partial pressures; or (2) passing the sample gas stream through a tared silica gel (or equivalent desiccant) trap with exit gases kept below 20°C (68°F) and determining the weight gain.

If means other than silica gel are used to determine the amount of moisture leaving the impinger train, it is recommended that silica gel (or equivalent) still be used between the impinger system and pump to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

NOTE: If a determination of particulate matter collected in the impingers is desired in addition to moisture content, the impinger system described above shall be

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NOTE: If a determination of particulate matter collected in the impingers is desired in addition to moisture content, the impinger system described above shall be

used, without modification. Individual control agencies requiring this information shall be contacted as to the sample recovery and analysis of the impinger contents.

2.1.8 Metering System. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within $3^{o}C$ ($5.4^{o}F$), dry gas meter capable of measuring volume to within 2 percent, and related equiment, as shown in Figure 5-1. Other metering systems capable of maintaining sampling rates within 10 percent of isokinetic and of determining sample volumes to within 2 percent may be used, subject to the approval of the Control Agency's Authorized Representative. When the metering system is used in conjunction with a pitot tube, the system shall enable checks of isokinetic rates.

Sampling trains utilizing metering systems designed for higher flow rates than that described in APTD-0581 or APTD-0576 may be used provided that the specifications of this method are met.

2.1.9 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station,

in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.10 Gas Density Determination Equipment. Temperature sensor and pressure gauge, as described in Sections 2.3 and 2.4 of Method 2, and gas analyzer, if necessary, as described in Method 3. The temperature sensor shall, preferably, be permanently attached to the pitot tube or sampling probe in a fixed configuration, such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal. Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see Method 2, Figure 2-7). As a second alternative, if a difference of not more than 1 percent in the average velocity measurement is to be introduced, the temperature gauge need not be attached to the probe or pitot tube. (This alternative is subject to the approval of the Control Agency's Authorized Representative.)

in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

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2.2 Sample Recovery. The following items are needed:

2.2.1 Probe-Liner and Probe-Nozzle Brushes. Nylon bristle brushes with stainless steel wire handles. The probe brush shall have extensions (at least as long as the probe) of stainless steel, Nylon, Teflon, or similarly inert material. The brushes shall be properly sized and shaped to brush out the probe liner and nozzle.

2.2.2 Wash Bottles - Two. Glass wash bottles are recommended; polyethylene wash bottles may be used at the option of the tester. It is recommended that acetone not be stored in polyethylene bottles for longer than a month.

2.2.3 Glass Sample Storage Containers. Chemically resistant, borosilicate glass bottles, for acetone washes, 500 ml or 1000 ml. Screw cap liners shall either be rubber-backed Teflon or shall be constructed so as to be leak-free and resistant to chemical attack by acetone. (Narrow mouth glass bottles have been found to be less prone to leakage.) Alternatively, polyethylene bottles may be used.

2.2.4 Petri Dishes. For filter samples, glass or polyethylene, unless otherwise specified by the Control Agency's Authorized Representative.

2.2.5 Graduated Cylinder and/or Balance. To measure condensed water to within 1 ml or 1g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. Any of these balances is suitable for use here and in Section 2.3.4.

2.2.6 Plastic Storage Containers. Air-tight containers to store silica gel.

2.2.7 Funnel and Rubber Policeman. To aid in transfer of silica gel to container; not necessary if silica gel is weighed in the field.

2.2.8 Funnel. Glass or polyethlene, to aid in sample recovery.

2.3 Analysis. For analysis, the following equipment is needed.

2.3.1 Glass Weighing Dishes.

2.3.2 Desiccator.

2.3.3 Analytical Balance. To measure to within 0.1 mg.

2.3.4 Balance. To measure to within 0.5 g.

2.2.5 Graduated Cylinder and/or Balance. To measure condensed water to within 1 ml or 1g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. Any of these balances is suitable for use here and in Section 2.3.4.

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2.3.2 Desiccator.

2.3.3 Analytical Balance. To measure to within 0.1 mg.

2.3.4 Balance. To measure to within 0.5 g.

2.3.5 Beakers. 250 ml.

2.3.6 Hygrometer. To measure the relative humidity of the laboratory environment.

2.3.7 Temperature Gauge. To measure the temperature of the laboratory environment.

3. Reagents

3.1 Sampling. The reagents used in sampling are as follows:

3.1.1 Filters. Glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency ($\leq$ 0.05 percent penetration) on 0.3-micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D2986-71. Test data from the supplier's quality control program are sufficient for this purpose.

3.1.2 Silica Gel. Indicating type, 6 to 16 mesh. If previously used, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Control Agency's Authorized Representative.

3.1.3 Water. When analysis of the material caught in the impingers is required, distilled water shall be used. Run blanks prior to field use to eliminate a high blank on test samples.

3.1.4 Crushed Ice.

3.1.5 Stopcock Grease. Acetone-insoluble, heat-stable silicone grease. This is not necessary if screw-on connectors with Teflon sleeves, or similar, are used. Alternatively, other types of stopcock grease may be use, subject to the approval of the Control Agency's Authorized Representative.

3.2 Sample Recovery. Acetone - reagent grade, $\leq$ 0.001 percent residue, in glass bottles - is required. Acetone from metal containers generally has a high residue blank and should not be used. Sometimes, suppliers transfer acetone to glass bottles from metal containers; thus, acetone blanks shall be run prior to field use and only acetone with low values ($\leq$0.001 percent) shall be used. In no case shall a blank value of greater than 0.001 percent of the weight of acetone used be subtracted from the sample weight.

3.3 Analysis. Two reagents are required for the analysis:

3.3.1 Acetone. Same as 3.2.

3.1.3 Water. When analysis of the material caught in the impingers is required, distilled water shall be used. Run blanks prior to field use to eliminate a high blank on test samples.

3.1.4 Crushed Ice.

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3.3 Analysis. Two reagents are required for the analysis:

3.3.1 Acetone. Same as 3.2.

3.3.2 Desiccant. Anhydrous calcium sulfate, indicating type. Alternatively, other types of desiccants may be used, subject to the approval of the Control Agency's Authorized Representative.

4. Procedure

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testors should be trained and experienced with the test procedures.

4.1.1 Pretest Preparation. All the components shall be maintained and calibrated according to the procedure described in APTD-0576, unless otherwise specified herein.

Weigh several 200 to 300 g portions of silica gel in air-tight containers to the nearest 0.5 g. Record the total weight of the silica gel plus container, on each container. As an alternative, the silica gel need not be preweighed, but may be weighed directly in its impinger or sampling holder just prior to train assembly.

Check filters visually against light for irregularities and flaws or pinhole leaks, Label filters of the proper diameter on the back side near the edge using numbering machine ink. As an alternative, label the shipping

containers (glass or plastic petri dishes) and keep the filters in these containers at all times except during sampling and weighing.

Desiccate the filters at 20 ± 5.6°C (68 ± 10°F) and ambient pressure for at least 24 hours and weigh at intervals of at least 6 hours to a constant weight, i.e., 0.5 mg change from previous weighing; record results to the nearest 0.1 mg. During each weighing the filter must not be exposed to the laboratory atmosphere for a period greater than 2 minutes and a relative humidity above 50 percent. Alternatively, (unless otherwise specified by the Control Agency's Authorized Representative), the filters may be oven dried at 105°C (220°F) for 2 to 3 hours, desiccated for 2 hours, and weighed. Procedures other than those described, which account for relative humidity effects, may be used, subject to the approval of the Control Agency's Authorized Representative.

4.1.2 Preliminary Determinations. Select the sampling site and the minimum number of sampling points according to Method 1 or as specified by the Control Agency's Authorized Representative. Determine the stack pressure, temperature, and the range of velocity heads using Method 2; it is recommended that a leak-check of the pitot lines

containers (glass or plastic petri dishes) and keep the filters in these containers at all times except during sampling and weighing.

Desiccate the filters at 20 ± 5.6°C (68 ± 10°F) and ambient pressure for at least 24 hours and weigh at intervals of at least 6 hours to a constant weight, i.e., 0.5 mg change from previous weighing; record results to the nearest 0.1 mg. During each weighing the filter must not be exposed to the laboratory atmosphere for a period greater than 2 minutes and a relative humidity above 50 percent. Alternatively, (unless otherwise specified by the Control Agency's Authorized Representative), the filters may be oven dried at 105°C (220°F) for 2 to 3 hours, desiccated for 2 hours, and weighed. Procedures other than those described, which account for relative humidity effects, may be used, subject to the approval of the Control Agency's Authorized Representative.

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(see Method 2, Section 3.1) be performed. Determine the moisture content using Approximation Method 4 or its alternative for the purpose of making isokinetic sampling rate settings. Determine the stack gas dry molecular weight, as described in Method 2, Section 3.6; if integrated Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the particulate sample run.

Select a nozzle size based on the range of velocity heads, such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Section 2.2 of Method 2).

Select a suitable probe liner and probe length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the length of probes.

Select a total sampling time greater than or equal to the minimum total sampling time specified in the test

procedures for the specific industry such that (1) the sampling time per point is not less than 2 min. (or some greater time interval as specified by the Control Agency's Authorized Representative), and (2) the sample volume taken (corrected to standard conditions) will exceed the required minimum total gas sample volume. The latter is based on an approximately average sampling rate.

It is recommended that the number of minutes sampled at each point be an integer or an integer plus one-half minute, in order to avoid timekeeping errors. The sampling time at each point shall be the same.

In some circumstances, e,g., batch cycles, it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas sample volumes. In these cases, the Control Agency's Authorized Representative's approval must first be obtained.

4.1.3 Preparation of Collection Train. During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.

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4.1.3 Preparation of Collection Train. During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.

Place 100 ml of water in each of the first two impingers, leave the third impinger empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fourth impinger. More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.

When glass liners are used, install the selected nozzle using a Viton A O-ring when stack temperatures are less than 260°C (500°F) and an asbestos string gasket when temperatures are higher. See APTD-0576 for details. Other connecting systems using either 316 stainless steel or Teflon ferrules may be used. When metal liners are used, install the nozzle as above or by a leak-free direct

mechanical connection. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

Set up the train as in Figure 5-1, using (if necessary) a very light coat of silicone grease on all ground glass joints, greasing only the outer portion (see APTD-0576) to avoid possibility of contamination by the silicone grease. Subject to the approval of the Control Agency's Authorized Representative, a glass cyclone may be used between the probe and filter holder when the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack gas.

Place crushed ice around the impingers.

4.1.4 Leak-Check Procedures.

4.1.4.1 Pretest Leak-Check. A pretest leak-check is required. The following procedure shall be used.

After the sampling train has been assembled, turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train

mechanical connection. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

Set up the train as in Figure 5-1, using (if necessary) a very light coat of silicone grease on all ground glass joints, greasing only the outer portion (see APTD-0576) to avoid possibility of contamination by the silicone grease. Subject to the approval of the Control Agency's Authorized Representative, a glass cyclone may be used between the probe and filter holder when the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack gas.

Place crushed ice around the impingers.

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After the sampling train has been assembled, turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train

at the sampling site by plugging the nozzle and pulling a 380 mm Hg (15 in. Hg) vacuum.

Note: A lower vacuum may be used, provided that it is not exceeded during the test.

If an asbestos string is used, do not connect the probe to the train during the leak-check. Instead, leak-check the train by first plugging the inlet to the filter holder (cyclone, if applicable) and pulling a 380 mm Hg (15 in. Hg) vacuum (see Note immediately above). Then connect the probe to the train and leak-cehck at about 25 mm Hg (1 in Hg) vacuum; alternatively, the probe may be leak-checked with the rest of the sampling train, in one step, at 380 mm Hg (15 in. Hg) vacuum. Leakage rates in excess of 4 percent of the average sampling rate or 0.00057 m^3/min (0.02 cfm), whichever is less, are unacceptable.

The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with bypass valve fully open and coarse adjust valve completely closed. Partially open the coarse adjust valve and

slowly close the bypass valve until the desired vacuum is reached. Do not reverse direction of bypass valve; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check as shown below and start over.

When the leak-check is completed, first slowly remove the plug from the inlet to the probe, filter holder, or cyclone (if applicable) and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica gel from being entrained backward into the third impinger.

4.1.4.2 Leak-Checks During Sample Run. If, during the sampling run, a component (e.g., filter assembly or impinger) change becomes necessary, a leak-check shall be conducted immediately before the change is made. The leak-check shall be done according to the procedure outlined in Section 4.1.4.1 above, except that it shall be done at a vacuum equal to or greater than the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4 percent

slowly close the bypass valve until the desired vacuum is reached. Do not reverse direction of bypass valve; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check as shown below and start over.

When the leak-check is completed, first slowly remove the plug from the inlet to the probe, filter holder, or cyclone (if applicable) and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica gel from being entrained backward into the third impinger.

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of the average sampling rate (whichever is less), the results are acceptable and no correction will need to be applied to the total volume of dry gas metered; if, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and plan to correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run. Immediately after component changes, leak-checks are optional; if such leak-checks are done, the procedure outlined in Section 4.1.4.1 above shall be used.

4.1.4.3 Post-test Leak-Check. A leak-check is mandatory at the conclusion of each sampling run. The leak-check shall be done in accordance with the procedures outlined in Section 4.1.4.1, except that it shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. If the leakage rate is found to be not greater than 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered. If, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run.

4.1.5 Particulate Train Operation. During the sampling run, maintain an isokinetic sampling rate (within 10 percent of true isokinetic unless otherwise specified by the Control Agency's Authorized Representative) and a temperature around the filter of 120 $\pm$ 14°C (248 $\pm$ 25°F), or such other temperature as specified by an applicable subpart of the standards or approved by the Control Agency's Authorized Representative.

For each run, record the data required on a data sheet such as the one shown in Figure 5-2. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak-check, and when sampling is halted. Take other readings required by Figure 5-2 at least once at each sample point during each time increment and additional readings when significant changes (20 percent variation in velocity head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

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Clean the portholes prior to the test run to minimize the chance of sampling deposited material. To begin sampling, remove the nozzle cap, verify that the filter and probe heating systems are up to temperature, and that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions (Note: During the period before sampling begins point the nozzle downstream. Rotate the nozzle upstream immediately before the sampling pump is turned on.) Nomographs are available, which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations. These nomographs are designed for use when the Type S pitot tube coefficient is 0.85 $\pm$ 0.02, and the stack gas equivalent density (dry molecular weight) is equal to 29 $\pm$ 4. APTD-0576 details the procedure for using the nomographs. If C_p and M_d are outside the above stated ranges do not use the nomographs unless appropriate steps are taken to compensate for the deviations. (See Citation 7 in Section 7.)

When the stack is under significant negative pressure (height of impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to

prevent water from backing into the filter holder. If necessary, the pump may be turned on with the coarse adjust valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

Traverse the stack cross-section, as required by Method 1 or as specified by the Control Agency's Authorized Representative, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes; this minimizes the chance of extracting deposited material.

During the test run, make periodic adjustments to keep the temperature around the filter holder at the proper level; add more ice and, if necessary, salt to maintain a temperature less than 20°C (68°F) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer.

If the pressure drop across the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of a sample run. It

prevent water from backing into the filter holder. If necessary, the pump may be turned on with the coarse adjust valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

Traverse the stack cross-section, as required by Method 1 or as specified by the Control Agency's Authorized Representative, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes; this minimizes the chance of extracting deposited material.

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If the pressure drop across the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of a sample run. It

is recommended that another complete filter assembly be used rather than attempting to change the filter itself. Before a new filter assembly is installed, conduct a leak-check (see Section 4.1.4.2) The total particulate weight shall include the summation of all filter assembly catches.

A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or, in cases where equipment failure necessitates a change of trains. In all other situations, the use of two or more trains will be subject to the approval of the Control Agency's Authorized Representative.

Note that when two or more trains are used, separate analyses of the front-half and (if applicable) impinger catches from each train shall be performed, unless identical nozzle sizes were used on all trains, in which case, the front-half catches from the individual trains may be combined (as may the impinger catches) and one analysis of front-half catch and one analysis of impinger catch may be performed. Consult with the Control Agency's Authorized Representative for details concerning the calculation of results when two or more trains are used.

At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry gas meter reading, and conduct a post-test leak-check, as outlined in Section 4.1.4.3. Also, leak-check the pitot lines as described in Method 2, Section 3.1; the lines must pass this leak-check, in order to validate the velocity head data.

4.1.6 Calculation of Percent Isokinetic. Calculate percent isokinetic (see Calculations, Section 6) to determine whether the run was valid or another test run should be made. If there was difficulty in maintaining isokinetic rates due to source conditions, consult with the Control Agency's Authorized Representative for possible variance on the isokinetic rates.

4.2 Sample Recovery. Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool.

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while the sampling train is cooling down as this would create a vacuum in the filter holder, thus drawing water from the impingers into the filter holder.

At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry gas meter reading, and conduct a post-test leak-check, as outlined in Section 4.1.4.3. Also, leak-check the pitot lines as described in Method 2, Section 3.1; the lines must pass this leak-check, in order to validate the velocity head data.

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Before moving the sample train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened and cap it. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.

Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.

Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used and place it in a glass sample container labeled "acetone blank."

Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

Container No. 1. Carefully remove the filter from the filter holder and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Carefully transfer to the petri dish any particulate matter and/or filter fibers which adhere to the filter holder gasket, by using a dry nylon bristle brush and/or a sharp-edged blade. Seal the container.

Container No. 2. Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate matter or any condensate from the probe nozzle, probe fitting, probe liner, and from half of the filter holder by washing these components with acetone and placing the wash in a glass container. Distilled water may be used instead of acetone when approved by the Control Agency's Authorized Representative and shall be used when specified by the Control Agency's Authorized Representative; in these cases, save a water blank and follow the Control Agency's Authorized Representative's directions on analysis. Perform the acetone rinses as follows:

Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a nylon bristle brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

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Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a nylon bristle brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

Brush and rinse the inside parts of the Swagelok fitting with acetone in a similar way until no visible particles remain.

Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces will be wetted with acetone. Let the acetone drain from the lower end into the sample container. A funnel (glass or polyethylene) may be used to aid in transferring liquid washes to the container. Follow the acetone rinse with a probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe; hold a sample container underneath the lower end of the probe, and catch any acetone and particulate matter which is brushed from the probe. Run the brush through the probe three times more until no visible particulate matter is carried out with the acetone or until none remains in the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above prescribed manner at least six times since metal probes have small crevices in which particulate matter can be entrapped. Rinse the brush with acetone, and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe as described above.

It is recommended that two people be used to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

After ensuring that all joints have been wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully rinse out the glass cyclone, also (if applicable). After all acetone washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that acetone will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Label the container to clearly identify its contents.

Container No. 3. Note the color of the indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fourth impinger to its original container and seal. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, follow the procedure for container No. 3 in Section 4.3.

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Impinger Water. Treat the impingers as follows: Make a notation of any color or film in the liquid catch. Measure the liquid which is in the first three impingers to within $\pm$ 1 ml by using a graduated cylinder or by weighing it to within $\pm$ 0.5 g by using a balance (if one is available). Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas. (See note, Section 2.1.7.)

If a different type of condenser is used, measure the amount of moisture condensed either volumetrically or gravimetrically. Whenever possible, containers should be shipped in such a way that they remain upright at all times.

4.2.1 Determination of the Particulate Concentration

The particulate matter concentration is determined by isokinetically aspirating a measured volume of the stack gas, catching the particulate in a filter, in the probe, connecting tubing, and in the impingers, and dividing the weight of the particulate catch by the volume of gas.

For the APCD rules, matter that is liquid at standard temperature must be included. This liquid matter is assumed to pass as a gas through the filter and to then condense in the impinger water. The weight of this liquid particulate is determined by solvent extraction using

methylene chloride followed by an aqueous phase extraction. Caution must therefore be used not to let any acetone or other non-water rinse enter the impinger water.

For the APCD rules, the combined weight of the particulate matter caught in the probe, the filter and the impingers is used in the determination of particulate matter concentration. For some rules only the combined weight of the particulate matter caught in the probe and filter is used in the determination. Accordingly, it is advisable to report the weight of the impinger catch separately so that both the APCD and the ARB determinations can be made. The total particulate matter catch may be itemized by weight as follows: (1) Filter Catch, (2) Probe Catch, (3) Impinger Catch, and (4) Solvent Extract.

4.3 Analysis. Record the data required on a sheet such as the one shown in Figure 5-3. Handle each sample container as follows:

Container No. 1. Leave the contents in the shipping container or transfer the filter and any loose particulate from the sample container to a tared glass weighing dish. Desiccate for 24 hours in a desiccator containing anhydrous calcium sulfate. Weigh to a constant weight and report the results to the nearest 0.1 mg. For purposes of this Section, 4.3, the term "constant weight" means a

methylene chloride followed by an aqueous phase extraction. Caution must therefore be used not to let any acetone or other non-water rinse enter the impinger water.

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difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of desiccation time between weighings.

Alternatively, the sample may be oven dried at 105°C (220°F) for 2 to 3 hours, cooled in the desiccator, and weighted to a constant weight, unless otherwise specified by the Control Agency's Authorized Representative. The tester may also opt to oven dry the sample at 105°C (220°F) for 2 to 3 hours, weigh the sample, and use this weight as a final weight.

Container No. 2. Note the level of liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Control Agency's Authorized Representative, to correct the final results. Measure the liquid in this container either volumetrically to $\pm$1 ml or gravimetrically to $\pm$0.5 g. Transfer the contents to a tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

Container No. 3. Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. This step may be conducted in the field.

"Acetone Blank" Container. Measure acetone in this container either volumetrically or gravimetrically. Transfer the acetone to a tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

Note - At the option of the tester, the contents of Container No. 2 as well as the acetone blank container may be evaporated at temperatures higher than ambient. If evaporation is done at an elevated temperature, the temperature must be below the boiling point of the solvent; also, to prevent "bumping," the evaporation process must be closely supervised, and the contents of the beaker must be swirled occasionally to maintain an even temperature. Use extreme care, as acetone is highly flammable and has a low flash point.

5. Calibration

Maintain a laboratory log of all calibrations.

5.1 Probe Nozzle. Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the inside diameter of nozzle to the nearest 0.025 mm (0.001 in.). Make three separate measurements using different diameters each time, and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in.). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identifed.

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Note - At the option of the tester, the contents of Container No. 2 as well as the acetone blank container may be evaporated at temperatures higher than ambient. If evaporation is done at an elevated temperature, the temperature must be below the boiling point of the solvent; also, to prevent "bumping," the evaporation process must be closely supervised, and the contents of the beaker must be swirled occasionally to maintain an even temperature. Use extreme care, as acetone is highly flammable and has a low flash point.

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5.2 Pitot Tube. The Type S pitot tube assembly shall be calibrated according to the procedure outlined in Section 4 of Method 2.

5.3 Metering System. Before its initial use in the field, the metering system shall be calibrated according to the procedure outlined in APTD-0576. Instead of physically adjusting the dry gas meter dial readings to correspond to the wet test meter readings, calibration factors may be used to mathematically correct the gas meter dial readings to the proper values. Before calibrating the metering system, it is suggested that a leak-check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump. For these cases the following leak-check procedure is suggested: make a 10-minute calibration run at 0.00057 m^3/min (0.02 cfm); at the end of the run, take the difference of the measured wet test meter and dry gas meter volumes; divide the difference by 10, to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

After each field use, the calibration of the metering systems shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test), with the vacuum set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet test meter and the inlet of the metering system. Calculate the average value of the calibration factor. If the calibration has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as outlined in APTD-0576.

Alternative procedures, e.g., using the orifice meter coefficients, may be used, subject to the approval of the Control Agency's Authorized Representative.

Note - If the dry gas meter coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

5.4 Probe Heater Calibration. The probe heating system shall be calibrated before its initial use in the field according to the procedure outlined in APTD-0576. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used.

5.5 Temperature Gauges. Use the procedure in section 4.3 of Method 2 to calibrate in-stack temperature gauges. Dial thermometers, such as are used for the dry gas meter and condenser outlet, shall be calibrated against mercury-in-glass thermometers.

5.6 Leak Check of Metering System Shown in Figure 5-1. That portion of the sampling train from the pump to the orifice meter should be leak-checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is

Alternative procedures, e.g., using the orifice meter coefficients, may be used, subject to the approval of the Control Agency's Authorized Representative.

Note - If the dry gas meter coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

5.4 Probe Heater Calibration. The probe heating system shall be calibrated before its initial use in the field according to the procedure outlined in APTD-0576. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used.

5.5 Temperature Gauges. Use the procedure in section 4.3 of Method 2 to calibrate in-stack temperature gauges. Dial thermometers, such as are used for the dry gas meter and condenser outlet, shall be calibrated against mercury-in-glass thermometers.

5.6 Leak Check of Metering System Shown in Figure 5-1. That portion of the sampling train from the pump to the orifice meter should be leak-checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is

actually sampled. The following procedure is suggested (see Figure 5-4): Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13 to 18 cm (5 to 7 in.) water column by blowing into the rubber tubing. Pinch off the tubing and observe the manometer for one minute. A loss of pressure on the manometer indicates a leak in the meter box; leaks, if present, must be corrected.

5.7 Barometer. Calibrate against a mercury barometer.

6. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used as long as they give equivalent results.

6.1 Nomenclature

A_n = Cross-sectional area of nozzle, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream, proportion by volume.

C_a = Acetone blank residue concentrations, mg/g.

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).

I = Percent of isokinetic sampling.

L_a = Maximum acceptable leakage rate for either a pretest leak-check or for a leak check following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.

L_i = Individual leakage rate observed during the leak-check conducted prior to the "ith" component change (i = 1, 2, 3, ...n), m^3/min (cfm).

L_p = Leakage rate observed during the post-test leak check m^3/min (cfm).

m_n = Total amount of particulate matter collected, mg.

M = Molecular weight of water, 18.0 g/g-mole. (18.0 lb/lb-mole).

m_a = Mass of residue of acetone after evaporation, mg.

P_{bar} = Barometric pressure at the sampling site, mm Hg (in Hg).

P_s = Absolute stack gas pressure, mm Hg (in Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).

R = Ideal gas constant 0.06236 mm Hg-$m^3/{}^oK$-g-mole (21.85 in Hg-$ft^3/{}^oR$-lb-mole).

T_m = Absolute average dry gas meter temperature (see Figure 5-2), ^oK (^oR). Note: T_m will depend on type of meter used and sampling configuration.

T_s = Absolute average stack gas temperature (see Figure 5-2), ^oK (^oR).

L_a = Maximum acceptable leakage rate for either a pretest leak-check or for a leak check following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.

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P_s = Absolute stack gas pressure, mm Hg (in Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).

R = Ideal gas constant 0.06236 mm Hg-$m^3/{}^oK$-g-mole (21.85 in Hg-$ft^3/{}^oR$-lb-mole).

T_m = Absolute average dry gas meter temperature (see Figure 5-2), ^oK (^oR). Note: T_m will depend on type of meter used and sampling configuration.

T_s = Absolute average stack gas temperature (see Figure 5-2), ^oK (^oR).

T_{std} = Standard absolute temperature, 293°K (528°R).

V_a = Volume of acetone blank, ml.

V_{aw} = Volume of acetone used in wash, ml.

V_{lc} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.

V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).

V_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec).

W_a = Weight of residue in acetone wash, mg.

Y = Dry gas meter calibration factor.

ΔH = Average pressure differential across the orifice meter (see Figure 5-2), mm H_2O (in H_2O).

p_a = Density of acetone, mg/ml (see label on bottle).

p_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

O = Total sampling time, min.

O_1 = Sampling time interval, from the beginning of a run until the first component change, min.

O_i = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.

θ_p = Sampling time interval, from the final (n^{th}) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions ($20^{o}C$, 760 mm Hg or $68^{o}F$, 29.92 in Hg) by using Equation 5-1.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left[\frac{P_{bar} + H/13.6}{P_{std}}\right] = K_1 V_m Y \frac{P_{bar} + (H/13.6)}{T_m}$$

Equation 5-1

where:

$K_1 = \frac{T_{std}}{P_{std}} = 0.3858^{o}K/mm$ Hg for metric units.

$= 17.64^{o}R/in$ Hg for English units.

Note: Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak-checks (i.e., the post-test leak-check or leak-checks conducted prior to component changes) exceeds L_a. If L_p or L_i exceeds L_a, Equation 5-1 must be modified as follows:

θ_p = Sampling time interval, from the final (n^{th}) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C, 760 mm Hg or 68°F, 29.92 in Hg) by using Equation 5-1.

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Equation 5-1

where:

$K_1 = \frac{T_{std}}{P_{std}} = 0.3858^{\circ}K/mm\ Hg$ for metric units.

$= 17.64^{\circ}R/in\ Hg$ for English units.

Note: Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak-checks (i.e., the post-test leak-check or leak-checks conducted prior to component changes) exceeds L_a. If L_p or L_i exceeds L_a, Equation 5-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace V_m in Equation 5-1 by the expression:

$$V_m - (L_p - L_a)\theta$$

(b) Case II. One or more component changes made during sampling run. In this case, replace V_m in Equation 5-1 by the expression:

$$V_m - (L_i - L_a)\theta_1 - \sum_{i=2}^{n} (L_i - L_a)\theta - (L_p - L_a)\theta_p$$

and substitute only for those leakage rates (L_i or L_p) which exceed L_a).

6.4 Volume of water vapor.

$$V_{w(std)} = V_{lc} \frac{p_w}{M_w} \frac{RT_{std}}{P_{std}} = K_2 V_{lc}$$

Equation 5-2

where:

K_2 = 0.001333 m^3/ml for metric units.

= 0.04707 ft^3ml for English units.

6.5 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

Equation 5-3

Note: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of B_{ws} shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is $\pm 1^{o}C$ ($2^{o}F$).

6.6 Acetone Blank Concentrations.

$$C_a = \frac{m_a}{V_a p_a}$$

Equation 5-4

6.7 Acetone Wash Blank.

$$W_a = C_a V_{aw} p_a$$

Equation 5-5

6.8 Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from containers 1 and 2 less the acetone blank (see Figure 5-3). Note - Refer to Section 4.1.5 to assist in calculations of results involving two or more filter assemblies or two or more sampling trains.

6.9 Particulate Concentration.

$$C_s = (0.001\ g/mg)\ (m_n/V_{m(std)})$$

Equation 5-6

Note: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of B_{ws} shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is $\pm 1^{o}C$ ($2^{o}F$).

6.6 Acetone Blank Concentrations.

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Equation 5-4

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Equation 5-5

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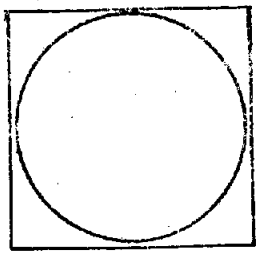
6.9 Particulate Concentration.

$$C_s = (0.001\ g/mg)\ (m_n/V_{m(std)})$$

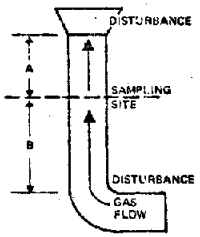
Equation 5-6

PARTICULATE FIELD DATA

SCHEMATIC OF STACK



CROSS SECTION



PLANT _____ AMBIENT TEMPERATURE _____ METER $\Delta H_@$ _____

DATE _____ BAROMETRIC PRESSURE _____ C FACTOR _____

LOCATION _____ ASSUMED MOISTURE, % _____ PROCESS WEIGHT RATE _____

OPERATOR _____ PROBE LENGTH, in. _____

STACK NO. _____ NOZZLE DIAMETER, in. _____

RUN NO. _____ STACK DIAMETER, in. _____

SAMPLE BOX NO. _____ PROBE HEATER SETTING _____

METER BOX NO. _____ HEATER BOX SETTING _____

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT		
TARE WEIGHT		
WEIGHT GAIN		
TOTAL		

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in. H_2O)	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD (ΔP_s)	($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in., H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (V_m), ft^3	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (Tm_{IN}), °F	OUTLET (Tm_{OUT}), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	VELOCITY fps
TOTAL														
AVERAGE														

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME, ml 1	2	3	4	SILICA GEL WEIGHT, g
FINAL					
INITIAL					
LIQUID COLLECTED					
TOTAL VOLUME COLLECTED					

ORSAT MEASUREMENT	TIME	CO_2	O_2	CO	N_2
1					
2					
3					
4					

COMMENTS:

FIGURE 5-2 PARTICULATE FIELD DATA

6.10 Conversion Factors:

From	To	Multiply by
scf	m^3	0.02832
g/ft^3	gr/ft^3	15.43
g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.31

6.11 Isokinetic Variation.

6.11.1 Calculation From Raw Data.

$$I = \frac{100\ T_s\ K_3 V_{lc} + (V_m/T_m)\ (P_{bar} + \Delta H/13.6)}{60\ \ 0 v_s P_s A_n}$$

Equation 5-7

where:

K_3 = 0.003454 mm Hg - m^3/ml - ^oK for metric units.

= 0.002669 in Hg - ft^3/ml - ^oR for English units.

6.11.2 Calculation from Intermediate Values

$$I = \frac{T_s V_{m(std)}\ P_{std}\ 100}{T_{std} V_s\ 0\ A_n P_s 60\ (1 - B_{ws})}$$

$$= K_4\ \frac{T_s V_{m(std)}}{P_s V_s A_n 0\ (1 - B_{ws})}$$

Equation 5-8

where:

K_4 = 4.320 for metric units.

= 0.09450 for English units.

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From	To	Multiply by
scf	m^3	0.02832
g/ft^3	gr/ft^3	15.43
g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.31

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$$= K_4 \frac{T_s V_{m(std)}}{P_s V_s A_n 0\ (1 - B_{ws})}$$

Equation 5-8

where:

K_4 = 4.320 for metric units.

= 0.09450 for English units.

Plant _____

Date _____

Run No. _____

Filter No. _____

Amount liquid lost during transport _____

Acetone blank volume, ml _____

Acetone wash volume, ml _____

Acetone blank concentration, mg/mg (equation 5-4) _____

Acetone wash blank, mg (equation 5-5) _____

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
TOTAL			
		Less acetone blank	
		Weight of particulate matter	

	VOLUME OF LIQUID WATER COLLECTED		
	IMPINGER VOLUME, ml.	SILICA GEL WEIGHT, g	
FINAL			
INITIAL			
LIQUID COLLECTED			
TOTAL VOLUME COLLECTED		g*	ml

* CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER (1g/ml).

$$\frac{\text{INCREASE, g}}{\text{1 g/ml}} = \text{VOLUME WATER, ml}$$

Figure 5-3. Analytical data.

Plant _____

Date _____

Run No. _____

Filter No. _____

Amount liquid lost during transport _____

Acetone blank volume, ml _____

Acetone wash volume, ml _____

Acetone blank concentration, mg/mg (equation 5-4) _____

Acetone wash blank, mg (equation 5-5) _____

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
TOTAL			
		Less acetone blank	
		Weight of particulate matter	

	VOLUME OF LIQUID WATER COLLECTED		
	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g	
FINAL			
INITIAL			
LIQUID COLLECTED			
TOTAL VOLUME COLLECTED		g*	ml

* CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER (1g/ml).

$$\frac{\text{INCREASE, g}}{\text{1 g/ml}} = \text{VOLUME WATER, ml}$$

Figure 5-3. Analytical data.

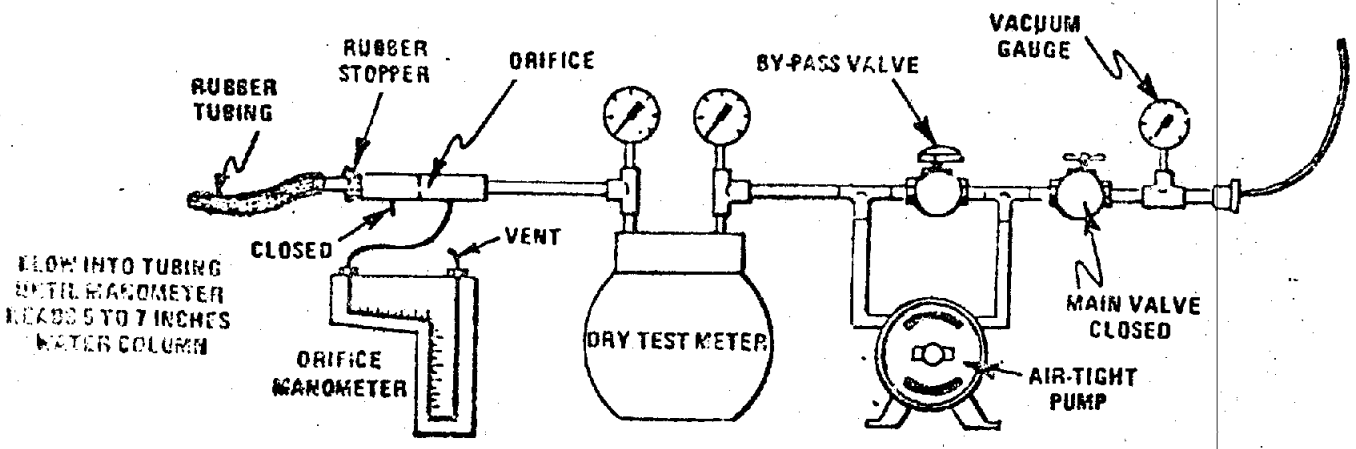

Figure 5-4. Leak check of meter box.

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3. Rom, Jerome J. Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment. Environmental Protection Agency. Research Triangle Park, NC. APTD-0576. March, 1972.

4. Smith, W.S., R.T. Shigehara, and W.F. Todd. A Method of Interpreting Stack Sampling Data. Paper Presented at the 63rd Annual Meeting of the Air Pollution Control Association, St. Louis, MO. June 14-19, 1970.

5. Smith, W.S., et al. Stack Gas Sampling Improved and Simplified with New Equipment. APCA Paper No. 67-119. 1967.

6. Specifications for Incinerator Testing at Federal Facilities. PHS, NCAPC. 1967.

7. Shigehara, R.T. Adjustments in the EPA Nomograph for Different Pitot Tube Coefficients and Dry Molecular Weights. Stack Sampling News 2:4-11. October, 1974.

8. Vollaro, R.F. A Survey of Commercially Available Instrumentation For the Measurement of Low-Range Gas Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch. Research Triangle Park, NC. November, 1976 (unpublished paper).

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METHOD 6 - DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle: A gas sample is extracted from the sampling point in the stack. The sulfuric acid mist (including sulfur trioxide) and the sulfur dioxide are separated. The sulfur dioxide fraction is measured by the barium-thorin titration method.

1.2 Applicability: This method is applicable for the determination of sulfur dioxide emissions from stationary sources. The minimum detectable limit of the method has been determined to be 3.4 milligrams (mg) of SO_2/m^3 ($2.12X10^{-7}$ lb/ft^3). Although no upper limit has been established, tests have shown that concentrations as high as 80,000 mg/m^3 of SO_2 can be collected efficiently in two midget impingers, each containing 15 milliliters of 3 percent hydrogen peroxide, at a rate of 1.0 lpm for 20 minutes. Based on theoretical calculations, the upper concentration limit in a 20-liter sample is about 93,300 mg/m^3.

Possible interferents are free ammonia, water-soluble cations, and fluorides. The cations and fluorides are removed by glass wool filters and an isopropanol

bubbler, and hence do not affect the SO_2 analysis. When samples are being taken from a gas stream with high concentrations of very fine metallic fumes (such as in inlets to control devices), a high-efficiency glass-fiber filter must be used in place of the glass wool plug (i.e., the one in the probe) to remove the cation interferents.

Free ammonia interferes by reacting with SO_2 to form particulate sulfite and by reacting with the indicator. If free ammonia is present (this can be determined by knowledge of the process and noticing white particulate matter in the probe and isopropanol bubbler), alternative methods subject to the approval of the Control Agency's Authorized Representative, are required.

2. Apparatus

2.1 Sampling. The sampling train is shown in Figure 6-1, and component parts are discussed below. The tester has the option of substituting sampling equipment described in Method 8 in place of the midget impinger equipment of Method 6. However, the Method 8 train must be modified to include a heated filter between the probe and isopropanol impinger, and the operation of the sampling train and sample analysis must be at the flow rates and solution volumes defined in Method 8.

bubbler, and hence do not affect the SO_2 analysis. When samples are being taken from a gas stream with high concentrations of very fine metallic fumes (such as in inlets to control devices), a high-efficiency glass-fiber filter must be used in place of the glass wool plug (i.e., the one in the probe) to remove the cation interferents.

Free ammonia interferes by reacting with SO_2 to form particulate sulfite and by reacting with the indicator. If free ammonia is present (this can be determined by knowledge of the process and noticing white particulate matter in the probe and isopropanol bubbler), alternative methods subject to the approval of the Control Agency's Authorized Representative, are required.

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2.1 Sampling. The sampling train is shown in Figure 6-1, and component parts are discussed below. The tester has the option of substituting sampling equipment described in Method 8 in place of the midget impinger equipment of Method 6. However, the Method 8 train must be modified to include a heated filter between the probe and isopropanol impinger, and the operation of the sampling train and sample analysis must be at the flow rates and solution volumes defined in Method 8.

The tester also has the option of determining SO_2 simultaneously with particulate matter and moisture determinations by (1) replacing the water in a Method 5 impinger system with 3 percent peroxide solution, or (2) by replacing the Method 5 water impinger system with a Method 8 isopropanol-filter-peroxide system. The analysis for SO_2 must be consistent with the procedure in Method 8.

2.1.1 Probe: Borosilicate glass, or stainless steel (other materials of construction may be used, subject to the approval of the Control Agency's Authorized Representative), approximately 6-mm inside diameter, with a heating system to prevent water condensation and a filter (either in-stack or heated out-stack) to remove particulate matter, including sulfuric acid mist. A plug of glass wool is a satisfactory filter.

2.1.2 Bubbler and Impingers: One midget bubbler, with medium-coarse glass frit and borosilicate or quartz glass wool packed in top (see Figure 6-1) to prevent sulfuric acid mist carryover, and three 30-ml midget impingers. The bubbler and midget impingers must be connected in series with leak-free glass connectors. Silicone grease may be used if necessary to prevent leakage.

At the option of the tester, a midget impinger may be used in place of the midget bubbler.

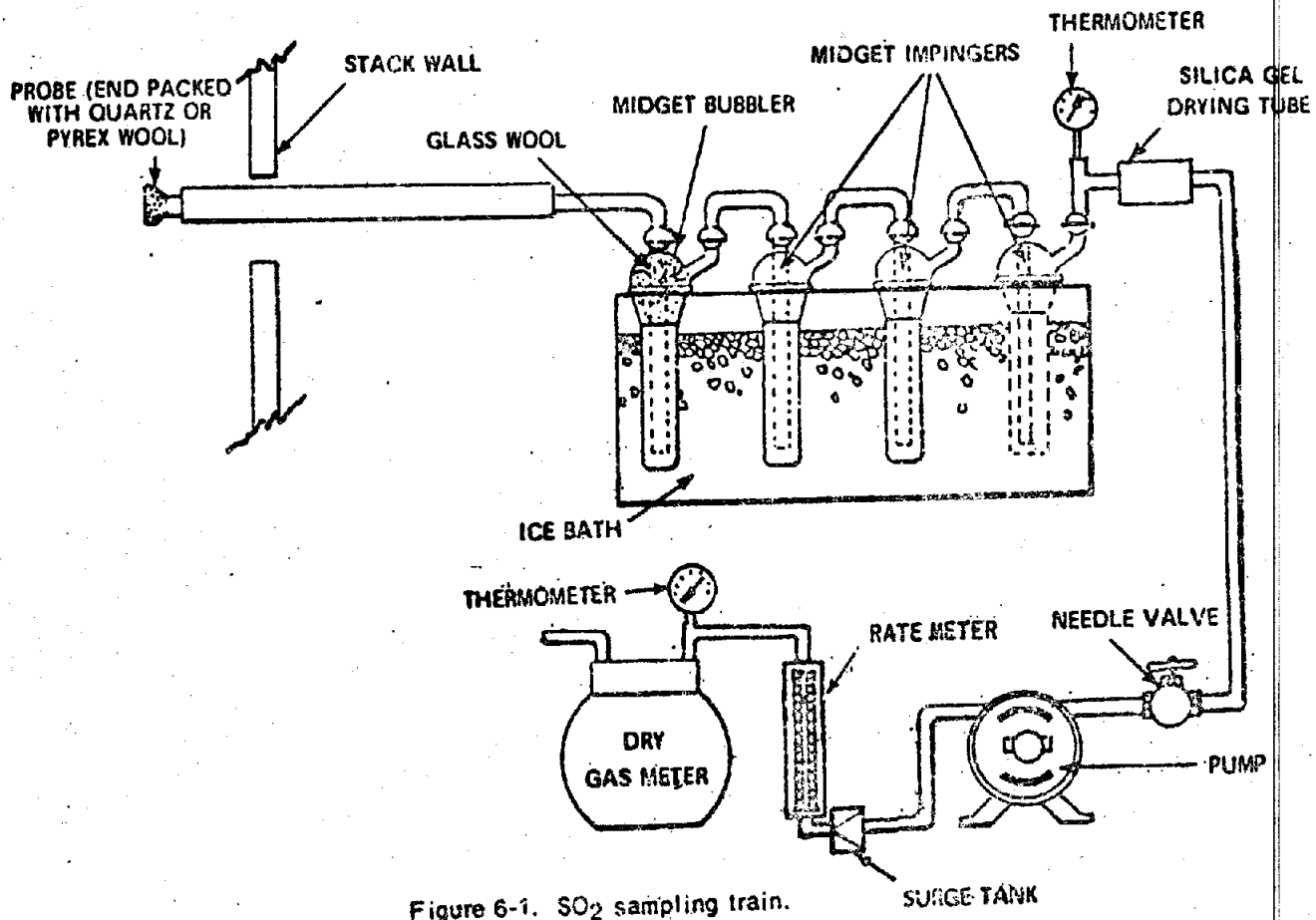

Figure 6-1. SO_2 sampling train.

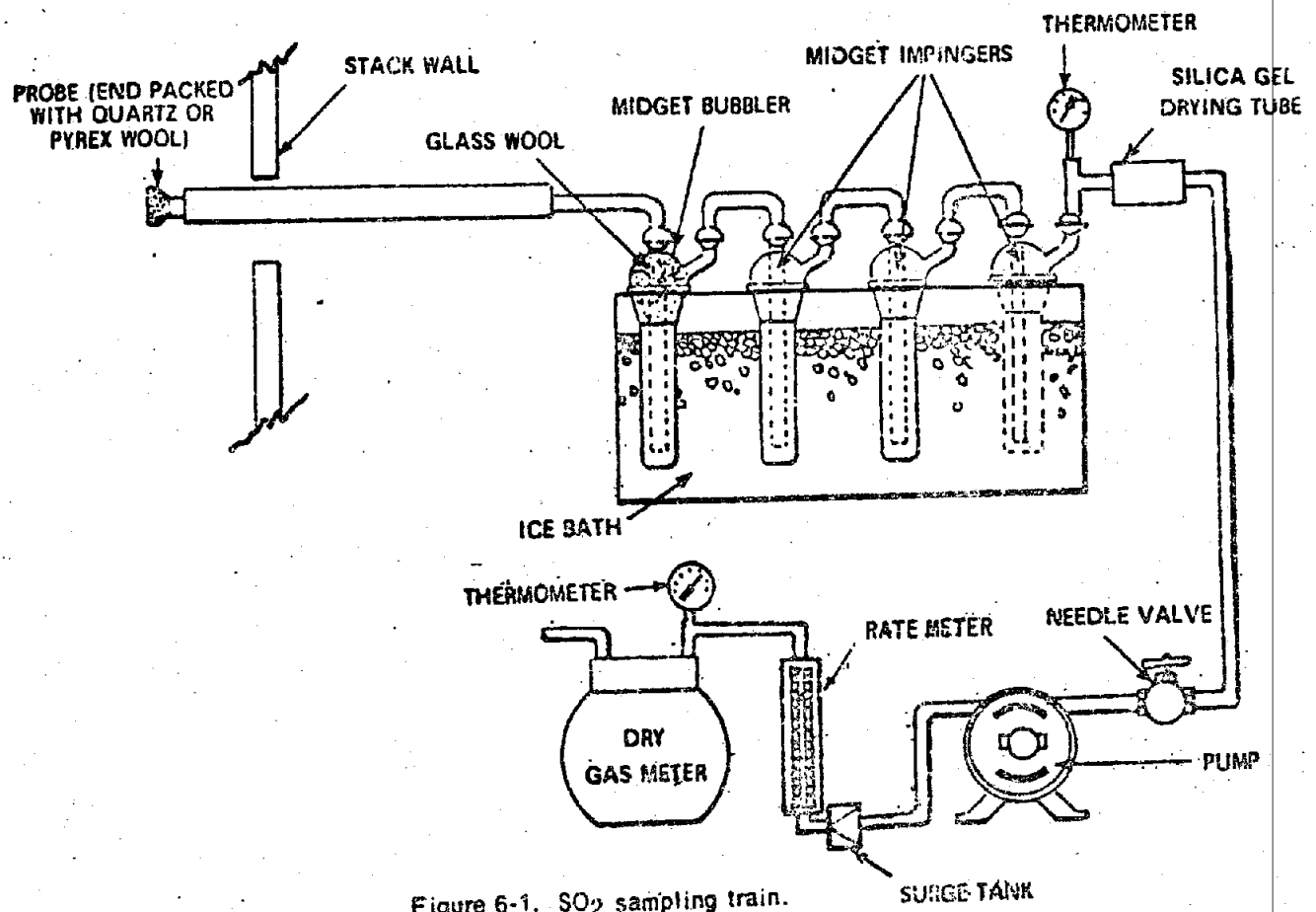

Figure 6-1. SO_2 sampling train.

Other collection absorbers and flow rates may be used, but are subject to the approval of the Control Agency's Authorized Representative. Also, collection efficiency must be shown to be at least 90 percent for each test run and must be documented in the report.

If the efficiency is found to be acceptable after a series of three tests, further documentation is not required. To conduct the efficiency test, an extra absorber must be added and analyzed separately. This extra absorber must not contain more than 1 percent of the total SO_2.

2.1.3 Glass Wool: Borosilicate or quartz.

2.1.4 Stopcock Grease: Acetone-insoluble, heat-stable silicone grease may be used, if necessary.

2.1.5 Temperature Gauge: Dial thermometer, or equivalent, to measure temperature of gas leaving impinger train to within 1°C (2°F).

2.1.6 Drying Tube: Tube packed with 6- to 16-mesh indicating type silica gel, or equivalent, to dry the gas sample and to protect the meter and pump. If the silica gel has been used previously, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. Alternatively,

other types of desiccants (equivalent or better) may be used, subject to approval of the Control Agency's Authorized Representative.

2.1.7 Valve: Needle valve, to regulate sample gas flow rate.

2.1.8 Pump: Leak-free diaphragm pump, or equivalent, to pull gas through the train. Install a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.1.9 Rate Meter: Rotameter, or equivalent, capable of measuring flow rate to within 2 percent of the selected flow rate of about 1000 cc/min.

2.1.10 Volume Meter: Dry gas meter, sufficiently accurate to measure the sample volume within 2 percent, calibrated at the selected flow rate and conditions actually encountered during sampling, and equipped with a temperature gauge (dial thermometer, or equivalent) capable of measuring temperature to within $3^{o}C$ ($5.4^{o}F$).

2.1.11 Barometer: Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute

other types of desiccants (equivalent or better) may be used, subject to approval of the Control Agency's Authorized Representative.

2.1.7 Valve: Needle valve, to regulate sample gas flow rate.

2.1.8 Pump: Leak-free diaphragm pump, or equivalent, to pull gas through the train. Install a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.1.9 Rate Meter: Rotameter, or equivalent, capable of measuring flow rate to within 2 percent of the selected flow rate of about 1000 cc/min.

2.1.10 Volume Meter: Dry gas meter, sufficiently accurate to measure the sample volume within 2 percent, calibrated at the selected flow rate and conditions actually encountered during sampling, and equipped with a temperature gauge (dial thermometer, or equivalent) capable of measuring temperature to within $3^{o}C$ ($5.4^{o}F$).

2.1.11 Barometer: Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute

barometric pressure) shall be requested and an adjustment for evaluation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) for 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.12 Vacuum Gauge and Rotameter: At least 760 mm Hg (30 in Hg) gauge and 0-40 cc/min rotameter to be used for leak check of the sampling train.

2.2 Sampling Recovery

2.2.1 Wash Bottles: Polyethylene or glass, 500 ml, two.

2.2.2 Storage Bottles: Polyethylene, 100 ml, to store impinger samples (one per sample).

2.3 Analysis

2.3.1 Pipettes: Volumetric type, 5-ml, 20-ml (one per sample), and 25-ml sizes.

2.3.2 Volumetric Flasks: 100-ml size (one per sample) and 1000-ml size.

2.3.3 Burettes: 5- and 50-ml sizes.

2.3.4 Erlenmeyer Flasks: 250-ml size (one for each sample, blank, and standard).

2.3.5 Dropping Bottle: 125-ml size, to add indicator.

2.3.6 Graduated Cylinder: 100-ml size.

2.3.7 Spectrophotometer: To measure absorbance at 352 nanometers.

3. Reagents

Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

3.1 Sampling.

3.1.1 Water: Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.1.2 Isopropanol, 80 Percent: Mix 80 ml of isopropanol with 20 ml of deionized, distilled water. Check each lot of

2.3.4 Erlenmeyer Flasks: 250-ml size (one for each sample, blank, and standard).

2.3.5 Dropping Bottle: 125-ml size, to add indicator.

2.3.6 Graduated Cylinder: 100-ml size.

2.3.7 Spectrophotometer: To measure absorbance at 352 nanometers.

3. Reagents

Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

3.1 Sampling.

3.1.1 Water: Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.1.2 Isopropanol, 80 Percent: Mix 80 ml of isopropanol with 20 ml of deionized, distilled water. Check each lot of

isopropanol for peroxide impurities as follows: shake 10 ml of isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of distilled water. After 1 minute, read the absorbance at 352 nanometers on a spectrophotometer. If absorbance exceeds 0.1, reject alcohol for use.

Peroxides may be removed from isopropanol by redistilling or by passage through a column of activated alumina; however, reagent grade isopropanol with suitable low peroxide levels may be obtained from commercial sources. Rejection of contaminated lots may, therefore, be a more efficient procedure.

3.1.3 Hydrogen Peroxide, 3 Percent: Dilute 30 percent hydrogen peroxide 1:9 (v/v) with deionized, distilled water (30 ml is needed per sample). Prepare fresh daily.

3.1.4 Potassium Iodide Solution, 10 Percent: Dissolve 10.0 grams KI in deionized, distilled water and dilute to 100 ml. Prepare when needed.

3.2 Sample Recovery.

3.2.1 Water: deionized, distilled as in 3.1.1.

3.2.2 Isopropanol, 80 Percent: Mix 80 ml of isopropanol with 20 ml of deionized, distilled water.

3.3 Analysis

3.3.1 Water: Deionized, distilled, as in 3.1.1.

3.3.2 Isopropanol, 100 Percent.

3.3.3 Thorin Indicator: 1-(o-arsonophenylazo)-2-naphthol-3, 6-disulfonic acid, disodium salt, or equivalent indicator. Dissolve 0.20 g in 100 ml of deionized, distilled water.

3.3.4 Barium Perchlorate Solution, 0.0100 N: Dissolve 1.95 g of barium perchlorate trihydrate [$Ba(ClO_4)_2.3H_2O$] in 200 ml distilled water and dilute to 1 liter with isopropanol. Alternatively, 1.22 g of [$BaCl_2.2H_2O$] may be used instead of the perchlorate. Standardize as in Section 5.5.

3.3.5 Sulfuric Acid Standard, 0.0100 N: Purchase or standardize to $\pm$0.0002N against 0.0100 N NaOH which has previously been standardized against potassium acid phthalate (primary standard grade).

4. Procedure

4.1 Sampling.

4.1.1 Preparation of Collection Train: Measure 15 ml of 80 percent isopropanol into the midget bubbler and 15 ml of 3 percent hydrogen peroxide into each of the first two

3.3 Analysis

3.3.1 Water: Deionized, distilled, as in 3.1.1.

3.3.2 Isopropanol, 100 Percent.

3.3.3 Thorin Indicator: 1-(o-arsonophenylazo)-2-naphthol-3, 6-disulfonic acid, disodium salt, or equivalent indicator. Dissolve 0.20 g in 100 ml of deionized, distilled water.

3.3.4 Barium Perchlorate Solution, 0.0100 N: Dissolve 1.95 g of barium perchlorate trihydrate [$Ba(ClO_4)_2.3H_2O$] in 200 ml distilled water and dilute to 1 liter with isopropanol. Alternatively, 1.22 g of [$BaCl_2.2H_2O$] may be used instead of the perchlorate. Standardize as in Section 5.5.

3.3.5 Sulfuric Acid Standard, 0.0100 N: Purchase or standardize to $\pm$0.0002N against 0.0100 N NaOH which has previously been standardized against potassium acid phthalate (primary standard grade).

4. Procedure

4.1 Sampling.

4.1.1 Preparation of Collection Train: Measure 15 ml of 80 percent isopropanol into the midget bubbler and 15 ml of 3 percent hydrogen peroxide into each of the first two

midget impingers. Leave the final midget impinger dry. Assemble the train as shown in Figure 6-1. Adjust the probe heater to a temperature sufficient to prevent water condensation. Place crushed ice and water around the impingers.

4.1.2 Leak-check Procedure: After assembly at the test site, the sampling train must be leak-checked. A leak-check after each sampling run is mandatory. The leak-check procedure is as follows:

Temporarily attach a suitable (e.g., 0-40 cc/min.) rotameter to the outlet of the dry gas meter and place a vacuum gauge at or near the probe inlet. Plug the probe inlet, pull a vacuum of at least 250 mm Hg (10 in Hg), and note the flow rate as indicated by the rotameter. A leakage rate not in excess of 2 percent of the average sampling rate is acceptable.

Note - Carefully release the proble inlet plug before turning off the pump.

It is suggested (not mandatory) that the pump be leak-checked separately, either prior to or after the sampling run. If done prior to the sampling run, the pubp leak-check shall precede the leak-check of the sampling

train described immediately above; if done after the sampling run, the pump leak-check shall follow the train leak-check. To leak check the pump, proceed as follows: Disconnect the drying tube from the probe-impinger assembly. Place a vacuum gauge at the inlet to either the drying tube or the pump, pull a vacuum of 250 mm Hg (10 in. Hg) at the inlet to either the drying tube or the pump, plug or pinch off the outlet of the flow meter, and then turn off the pump. The vacuum should remain stable for at least 30 seconds.

Other leak-check procedures may be used, subject to the approval of the Control Agency's Authorized Representative. The procedure used in Method 5 is not suitable for diaphragm pumps.

4.1.3 Sample Collection: Record the initial dry gas meter reading and barometric pressure. To begin sampling, position the tip of the probe at the sampling point, connect the probe to the bubbler, and start the pump. Adjust the sample flow to a constant rate of approximately 1.0 liter/min as indicated by the rotameter. Maintain this constant rate ($\pm$10 percent) during the entire sampling run. Take readings (dry gas meter, temperatures at dry gas meter and at impinger outlet and rate meter) at least every 5 minutes. Add more ice during the run to

train described immediately above; if done after the sampling run, the pump leak-check shall follow the train leak-check. To leak check the pump, proceed as follows: Disconnect the drying tube from the probe-impinger assembly. Place a vacuum gauge at the inlet to either the drying tube or the pump, pull a vacuum of 250 mm Hg (10 in. Hg) at the inlet to either the drying tube or the pump, plug or pinch off the outlet of the flow meter, and then turn off the pump. The vacuum should remain stable for at least 30 seconds.

Other leak-check procedures may be used, subject to the approval of the Control Agency's Authorized Representative. The procedure used in Method 5 is not suitable for diaphragm pumps.

4.1.3 Sample Collection: Record the initial dry gas meter reading and barometric pressure. To begin sampling, position the tip of the probe at the sampling point, connect the probe to the bubbler, and start the pump. Adjust the sample flow to a constant rate of approximately 1.0 liter/min as indicated by the rotameter. Maintain this constant rate ($\pm$10 percent) during the entire sampling run. Take readings (dry gas meter, temperatures at dry gas meter and at impinger outlet and rate meter) at least every 5 minutes. Add more ice during the run to

keep the temperature of the gases leaving the last impinger at 20°C (68°F) or less. At the conclusion of each run, turn off the pump, remove probe from the stack, and record the final readings. Conduct a leak check as in Section 4.1.2. (This leak check is mandatory.) If a leak is found, void the test run or, if appropriate, use procedures acceptable to the Control Agency's Authorized Representative to adjust the sample volume for leakage. Drain the ice bath, and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes at the sampling rate.

Clean ambient air can be provided by passing air through a charcoal filter or through an extra midget impinger with 15 ml of 3 percent H_2O_2. The tester may opt to simply use ambient air, without purification.

4.2 Sample Recovery: Disconnect the impingers after purging. Discard the contents of the midget bubbler. Pour the contents of the midget impingers into a leak-free polyethylene bottle for shipment. Rinse the three midget impingers and the connecting tubes with deionized, distilled water, and add the washings to the same storage container. Mark the fluid level. Seal and identify the sample container.

4.3 Sample Analysis: Note level of liquid in container, and confirm whether any sample was lost during shipment; note this on analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Control Agency's Authorized Representative, to correct the final results.

Transfer the contents of the storage container to a 100-ml volumetric flask and dilute to exactly 100 ml with deionized, distilled water. Pipette a 20-ml aliquot of this solution into a 250-ml Erlenmeyer flask, add 80 ml of 100 percent isopropanol and two to four drops of thorin indicator, and titrate to a pink end-point using 0.0100 N barium perchlorate. Repeat and average the titration volumes. Run a blank with each series of samples. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is larger.

(Note - Protect the 0.0100 N barium perchlorate solution from evaporation at all times.)

5. Calibration

5.1 Metering System.

5.1.1 Initial Calibration: Before its initial use in the field, first leak check the metering system (drying tube, needle valve, pump, rotameter, and dry gas meter) as follows: place a vacuum gauge at the inlet to the drying tube and

4.3 Sample Analysis: Note level of liquid in container, and confirm whether any sample was lost during shipment; note this on analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Control Agency's Authorized Representative, to correct the final results.

Transfer the contents of the storage container to a 100-ml volumetric flask and dilute to exactly 100 ml with deionized, distilled water. Pipette a 20-ml aliquot of this solution into a 250-ml Erlenmeyer flask, add 80 ml of 100 percent isopropanol and two to four drops of thorin indicator, and titrate to a pink end-point using 0.0100 N barium perchlorate. Repeat and average the titration volumes. Run a blank with each series of samples. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is larger.

(Note - Protect the 0.0100 N barium perchlorate solution from evaporation at all times.)

5. Calibration

5.1 Metering System.

5.1.1 Initial Calibration: Before its initial use in the field, first leak check the metering system (drying tube, needle valve, pump, rotameter, and dry gas meter) as follows: place a vacuum gauge at the inlet to the drying tube and

pull a vacuum of 250 mm (10 in.) Hg; plug or pinch off the outlet or the flow meter, and then turn off the pump. The vacuum shall remain stable for at least 30 seconds. Carefully release the vacuum gauge before releasing the flow meter end.

Next, calibrate the metering system (at the sampling flow rate specified by the method) as follows: connect an appropriately sized wet test meter (e.g., 1 liter per revolution) to the inlet of the drying tube. Make three independent calibration runs, using at least five revolutions of the dry gas meter per run. Calculate the calibration factor, Y (wet test meter calibration volume divided by the dry gas meter volume, both volumes adjusted to the same reference temperature and pressure), for each run, and average the results. If any Y value deviates by more than 2 percent from the average, the metering system is unacceptable for use. Otherwise, use the average as the calibration factor for subsequent test runs.

5.1.2 Post-Test Calibration Check: After each field test series, conduct a calibration check as in Section 5.1.1 above, except for the following variations: (a) the leak check is not to be conducted, (b) three, or more revolutions of the dry gas meter may be used,

and (c) only two independent runs need be made. If the calibration factor does not deviate by more 5 percent from the initial calibration factor (determined in Section 5.1.1), then the dry gas meter volumes obtained during the test series are acceptable. If the calibration factor deviates by more than 5 percent, recalibrate the metering system as in Section 5.1.1, and for the calculations, use the calibration factor (initial or recalibration) that yields the lower gas volume for each test run.

5.2 Thermometers. Calibrate against mercury-in-glass thermometers.

5.3 Rotameter: The rotameter need not be calibrated but should be cleaned and maintained according to the manufacturer's instruction.

5.4 Barometer: Calibrate against a mercury barometer.

5.5 Barium Perchlorate Solution: Standardize the barium perchlorate solution against 25 ml of standard sulfuric acid to which 100 ml of 100 percent isopropanol has been added.

and (c) only two independent runs need be made. If the calibration factor does not deviate by more 5 percent from the initial calibration factor (determined in Section 5.1.1), then the dry gas meter volumes obtained during the test series are acceptable. If the calibration factor deviates by more than 5 percent, recalibrate the metering system as in Section 5.1.1, and for the calculations, use the calibration factor (initial or recalibration) that yields the lower gas volume for each test run.

5.2 Thermometers. Calibrate against mercury-in-glass thermometers.

5.3 Rotameter: The rotameter need not be calibrated but should be cleaned and maintained according to the manufacturer's instruction.

5.4 Barometer: Calibrate against a mercury barometer.

5.5 Barium Perchlorate Solution: Standardize the barium perchlorate solution against 25 ml of standard sulfuric acid to which 100 ml of 100 percent isopropanol has been added.

6. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

6.1 Nomeclature.

C_{SO_2} = Concentration of sulfur dioxide, dry basis corrected to standard conditions, mg/dscm (lb/dscf).

N = Normality of barium perchlorate titrant, milliequivalents/ml.

P_{bar} = Barometric pressure at the exit orifice of the dry gas meter, mm Hg (in Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).

T_m = Average dry gas meter absolute temperature, ^{o}K (^{o}R).

T_{std} = Standard absolute temperature, 293°K (528°R).

V_s = Volume of sample aliquot titrated, ml.

V_m = Dry gas volume as measured by the dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

V_{soln} = Total volume of solution in which the sulfur dioxide sample is contained, 100 ml.

V_t = Volume of barium perchlorate titrant used for the sample, ml (average of replicate titrations).

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

Y = Dry gas meter calibration factor.

32.03 = Equivalent weight of sulfur dioxide.

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METHOD 7 - DETERMINATION OF NITROGEN OXIDE EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle: A grab sample is collected in an evacuated flask containing a dilute sulfuric acid-hydrogen peroxide absorbing solution, and the nitrogen oxides, except nitrous oxide, are measured colorimeterically using the phenoldisulfonic acid (PDS) procedure.

1.2 Applicability: This method is applicable to the measurement of nitrogen oxides emitted from stationary sources. The range of the method has been determined to be 2 to 400 milligrams NO_x (as NO_2) per dry standard cubic meter, without having to dilute the sample.

2. Apparatus

2.1 Sampling (see Figure 7-1): Other grab sampling systems or equipment, capable of measuring sample volume to within $\pm$2.0 percent and collecting a sufficient sample volume to allow analytical reproducibility to within $\pm$5 percent will be considered acceptable alternatives, subject to approval of the Control Agency's Authorized Representative. The following equipment is used in sampling:

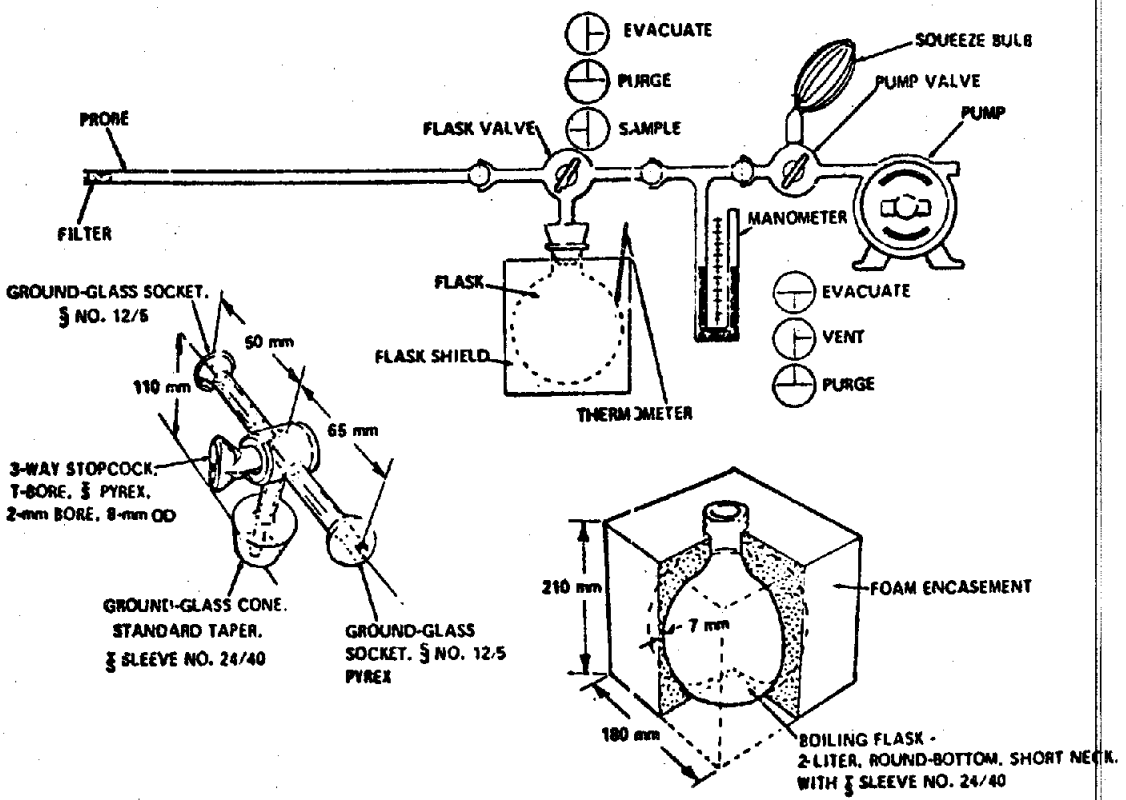

Figure 7-1. Sampling train, flask valve, and flask.

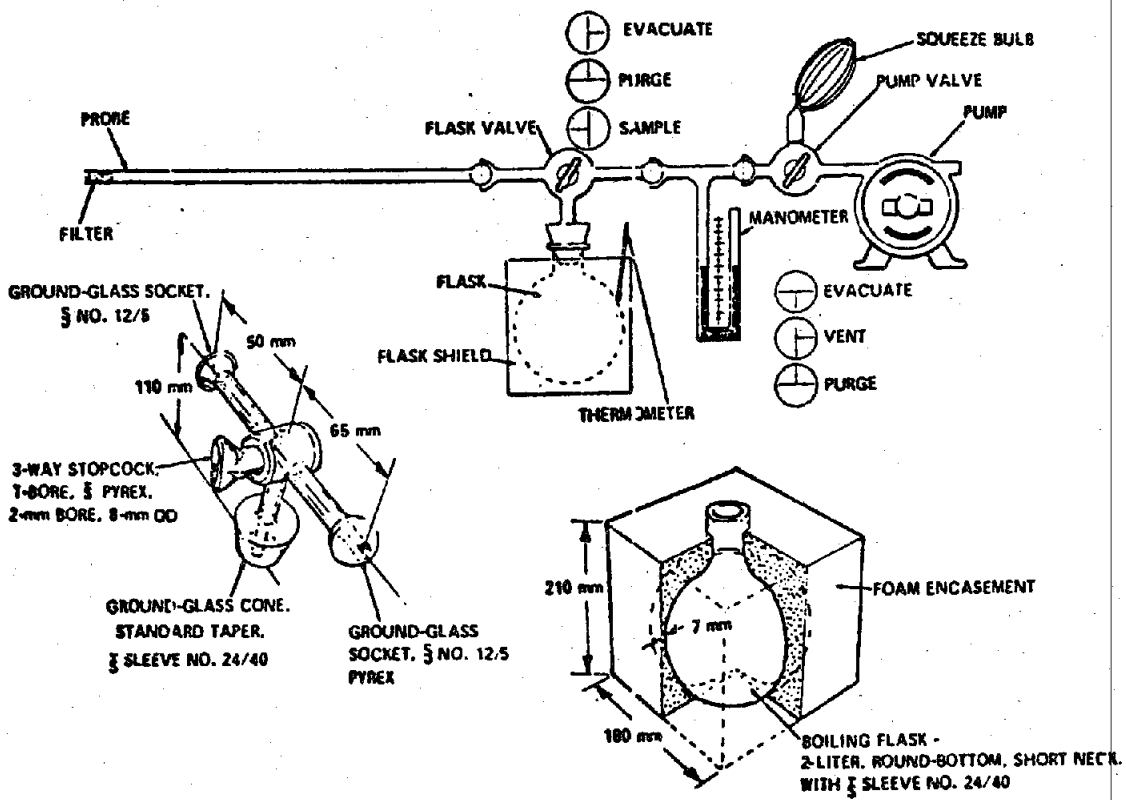

Figure 7-1. Sampling train, flask valve, and flask.

2.1.1 Probe: Borosilicate glass tubing, sufficiently heated to prevent water condensation and equipped with an in-stack or out-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Stainless steel or Teflon[1/] tubing may also be used for the probe. Heating is not necessary if the probe remains dry during the purging period.

2.1.2 Collection Flask: Two-liter borosilicate, round bottom flask, with short neck and 24/40 standard taper opening, protected against implosion or breakage.

2.1.3 Flask Valve: T-bore stopcock connected to a 24/40 standard taper joint.

2.1.4 Temperature Gauge: Dial-type thermometer, or other temperature gauge, capable of measuring 1°C (2°F) intervals for -5 to 50°C (25 to 125°F).

2.1.5 Vacuum Line: Tubing capable of withstanding a vacuum of 75 mm Hg (3 in. Hg) absolute pressure, with "T" connection and T-bore stopcock.

1/Mention of trade names or specific products does not constitute endorsement by the Air Resources Board.

2.1.6 Vacuum Gauge: U-tube manometer, 1 meter (36 in.), with 1-mm (0.1-in.) divisions, or other gauge capable of measuring pressure to withjn ±2.5 mm Hg (0.10 in. Hg).

2.1.7 Pump: Capable of evacuating the collection flask to a pressure equal to or less than 77 mm Hg (3 in. Hg) absolute.

2.1.8 Squeeze Bulb: One-way.

2.1.9 Volumetric Pipette: 25 ml.

2.1.10 Stopcock and Ground Joint Grease: A high-vacuum, high-temperature chlorofluorocarbon grease is required. Halocarbon 25-5S has been found to be effective.

2.1.11 Barometer: Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase, or vice versa for elevation decrease.

2.1.6 Vacuum Gauge: U-tube manometer, 1 meter (36 in.), with 1-mm (0.1-in.) divisions, or other gauge capable of measuring pressure to within ±2.5 mm Hg (0.10 in. Hg).

2.1.7 Pump: Capable of evacuating the collection flask to a pressure equal to or less than 77 mm Hg (3 in. Hg) absolute.

2.1.8 Squeeze Bulb: One-way.

2.1.9 Volumetric Pipette: 25 ml.

2.1.10 Stopcock and Ground Joint Grease: A high-vacuum, high-temperature chlorofluorocarbon grease is required. Halocarbon 25-5S has been found to be effective.

2.1.11 Barometer: Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase, or vice versa for elevation decrease.

2.2 Sample Recovery: The following equipment is required for sample recovery.

2.2.1 Graduated Cylinder: 50 ml with 1-ml divisions.

2.2.2 Storage Containers: Leak-free polyethylene bottles.

2.2.3 Wash Bottle: Polyethylene or glass.

2.2.4 Glass Stirring Rod.

2.2.5 Test Paper for Indicating pH: To cover the pH range of 7 to 14.

2.3 Analysis: For the analysis, the following equipment is needed:

2.3.1 Volumetric Pipettes: Two 1 ml, two 2 ml, one 3 ml, one 4 ml, two 10 ml, and one 25 ml for each sample and standard.

2.3.2 Procelain Evaporting Dishes: 175- to 250-ml capacity with lip for pouring, one for each sample and each standard. The Coors No. 45006 (shallow-form, 195 ml) has been found to be satisfactory. Alternatively, polymethyl pentene beakers (Nalge No. 1203, 150 ml), or glass beakers (150 ml) may be used. When glass beakers are used, etching of the beakers may cause solid matter to be present in the analytical step; the solids should be removed by filtration (see Section 4.3).

2.3.3 Steam Bath: Low-temperature ovens or thermostatically controlled hot plates kept below 70°C (160°F) are acceptable alternatives.

2.3.4 Dropping Pipette or Dropper: Three required.

2.3.5 Polyethylene Policeman. One for each sample and each standard.

2.3.6 Graduated Cylinder: 100 ml with 1-ml divisions.

2.3.7 Volumetric Flasks: 50 ml (one for each sample and each standard) 100 ml (one for each sample and each standard, and one for the working standard KNO_3 solution), and 1000 ml (one).

2.3.8 Spectrophotometer: To measure absorbance at 410 nm.

2.3.9 Graduated Pipette: 10 ml with 0.1-ml divisions.

2.3.10 Test Paper for Indicating pH: To cover the pH range of 7 to 14.

2.3.11 Analytical Balance: To measure to within 0.1 mg.

2.3.3 Steam Bath: Low-temperature ovens or thermostatically controlled hot plates kept below 70°C (160°F) are acceptable alternatives.

2.3.4 Dropping Pipette or Dropper: Three required.

2.3.5 Polyethylene Policeman. One for each sample and each standard.

2.3.6 Graduated Cylinder: 100 ml with 1-ml divisions.

2.3.7 Volumetric Flasks: 50 ml (one for each sample and each standard) 100 ml (one for each sample and each standard, and one for the working standard KNO_3 solution), and 1000 ml (one).

2.3.8 Spectrophotometer: To measure absorbance at 410 nm.

2.3.9 Graduated Pipette: 10 ml with 0.1-ml divisions.

2.3.10 Test Paper for Indicating pH: To cover the pH range of 7 to 14.

2.3.11 Analytical Balance: To measure to within 0.1 mg.

3. Reagents

Unless otherwise indicated, it is intended that all reagent conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available; otherwise, use the best available grade.

3.1 Sampling: To prepare the absorbing solution, cautiously add 2.8 ml concentrated H_2SO_4 to 1 liter of deionized, distilled water. Mix well and add 6 ml of 3 percent hydrogen peroxide, freshly prepared from 30 percent hydrogen peroxide solution. The absorbing solution should be used within 1 week of its preparation. Do not expose to extreme heat or direct sunlight.

3.2 Sample Recovery: Two reagents are required for sample recovery:

3.2.1 Sodium (1N): Dissolve 40 g NaOH in deionized, distilled water and dilute to 1 liter.

3.2.2 Water: Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMNO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.3 Analysis: For the analysis, the following reagents are required:

3.3.1 Fuming Sulfuric Acid: 15 to 18 percent by weight free sulfur trioxide. HANDLE WITH CAUTION.

3.3.2 Phenol: White solid.

3.3.3 Sulfuric Acid: Concentrated, 95 percent minimum assay. HANDLE WITH CAUTION.

3.3.4 Potassium Nitrate: Dried at 105 to 110°C (220 to 230°F) for a minimum of 2 hours just prior to preparation of standard solution.

3.3.5 Standard KNO_3 Solution: Dissolve exactly 2.198 g of dried potassium nitrate (KNO_3) in deionized, distilled water and dilute to 1 liter with deionized, distilled water in a 1,000-ml volumetric flask.

3.3.6 Working Standard KNO_3 Solution: Dilute 10 ml of the standard solution to 100 ml with deionized, distilled water. One milliliter of the working standard solution is equivalent to 100 ug nitrogen dioxide (NO_2).

3.3.7 Water: Deionized, distilled as in Section 3.2.2.

3.3.8 Phenoldisulfonic Acid Solution: Dissolve 25 g of pure white phenol in 150 ml concentrated sulfuric acid on a steam bath. Cool, add 75 ml fuming sulfuric acid, and heat at 100°C (212°F) for 2 hours. Store in a dark, stoppered bottle.

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3.3.7 Water: Deionized, distilled as in Section 3.2.2.

3.3.8 Phenoldisulfonic Acid Solution: Dissolve 25 g of pure white phenol in 150 ml concentrated sulfuric acid on a steam bath. Cool, add 75 ml fuming sulfuric acid, and heat at 100°C (212°F) for 2 hours. Store in a dark, stoppered bottle.

4. Procedure

4.1 Sampling.

4.1.1 Pipette 25 ml of absorbing solution into a sample flask, retaining a sufficient quantity for use in preparing the calibration standards. Insert the flask valve stopper into the flask with the valve in the "purge" position. Assemble the sampling train as shown in Figure 7-1 and place the probe at the sampling point. Make sure that all fittings are tight and leak-free, and that all ground glass joints have been properly greased with a high-vacuum, high-temperature chlorofluorocarbon-based stopcock grease. Turn the flask valve and the pump valve to their "evacuate" positions. Evacuate the flask to 75 mm Hg (3 in. Hg) absolute pressure, or less. Evacuation to a pressure approaching the vapor pressure of water at the existing temperature is desirable. Turn the pump valve to its "vent" position and turn off the pump. Check for leakage by observing the manometer for any pressure fluctuation. (Any variation greater than 10 mm Hg (0.4 in. Hg) over a period of 1 minute is not acceptable, and the flask is not to be used until the leakage problem is corrected. Pressure in the flask is not to exceed 75 mm Hg (3 in. Hg) absolute at the time sampling is commenced.) Record the volume of the flask and valve (V_f), the flask temperature (T_i), and the barometric

pressure. Turn the flask valve counterclockwise to its "purge" position and do the same with the pump valve. Purge the probe and the vacuum tube using the squeeze bulb. If condensation occurs in the probe and the flask vave area, heat the probe and purge until the condensation disappears. Next, turn the pump valve to its "vent" position. Turn the flask valve clockwise to its "evacuate" position and record the difference in the mercury levels in the manometer. The absolute internal pressure in the flask (P_i) is equal to the barometric pressure less the manometer reading. Immediately turn the flask valve to the "sample" position and permit the gas to enter the flask until pressures in the flask and sample line (i.e., duct, stack) are equal. This will usually require about 15 seconds; a longer period indicates a "plug" in the probe, which must be corrected before sampling is continued. After collecting the sample, turn the flask valve to its "purge" position and disconnect the flask from the sampling train. Shake the flask for at least 5 minutes.

4.1.2 If the gas being sampled contains insufficient oxygen for the conversion of NO to NO_2 (e.g., an applicable subpart of the standard may require taking a sample of a calibration gas mixture of NO in N_2), then oxygen shall

pressure. Turn the flask valve counterclockwise to its "purge" position and do the same with the pump valve. Purge the probe and the vacuum tube using the squeeze bulb. If condensation occurs in the probe and the flask vave area, heat the probe and purge until the condensation disappears. Next, turn the pump valve to its "vent" position. Turn the flask valve clockwise to its "evacuate" position and record the difference in the mercury levels in the manometer. The absolute internal pressure in the flask (P_i) is equal to the barometric pressure less the manometer reading. Immediately turn the flask valve to the "sample" position and permit the gas to enter the flask until pressures in the flask and sample line (i.e., duct, stack) are equal. This will usually require about 15 seconds; a longer period indicates a "plug" in the probe, which must be corrected before sampling is continued. After collecting the sample, turn the flask valve to its "purge" position and disconnect the flask from the sampling train. Shake the flask for at least 5 minutes.

4.1.2 If the gas being sampled contains insufficient oxygen for the conversion of NO to NO_2 (e.g., an applicable subpart of the standard may require taking a sample of a calibration gas mixture of NO in N_2), then oxygen shall

be introduced into the flask to permit this conversion. Oxygen may be introduced into the flask by one of three methods; (1) before evacuating the sampling flask, flush with pure cylinder oxygen, then evacuate flask to 75 mm Hg (3 in. Hg) absolute pressure or less; or (2) inject oxygen into the flask after sampling; or (3) terminate sampling with a minimum of 50 mm Hg (2 in. Hg) vacuum remaining in the flask, record this final pressure, and then vent the flask to the atmosphere until the flask pressure is almost equal to atmospheric pressure.

4.2 Sample Recovery: Let the flask set for a minimum of 16 hours and then shake the contents for 2 minutes. Connect the flask to a mercury filled U-tube manometer. Open the valve from the flask to the manometer and record the flask temperature (T_f), the barometric pressure, and the difference between the mercury levels in the manometer. The absolute internal pressure in the flask (P_f) is the barometric pressure less the manometer reading. Transfer the contents of the flask to a leak-free polyethylene bottle. Rinse the flask twice with 5-ml portions of deionized, distilled water and add the rinse water to the bottle. Adjust the pH to between 9 and 12 by adding sodium hydroxide (1 N), dropwise (about 25 to 35 drops). Check the pH by dipping a stirring rod into the solution and then touching the rod to the pH test paper. Remove as little material as possible during this step. Mark the height of the liquid level so

that the container can be checked for leakage after transport. Label the container to clearly identify its contents. Seal the container for shipping.

4.3 Analysis: Note the level of the liquid in the container and confirm whether or not any sample was lost during shipment; note this on the analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Control Agency's Authorized Representative, to correct the final results. Immediately prior to the analysis, transfer the contents of the shipping container to a 50-ml volumetric flask, and rinse the container twice with 5-ml portions of deionized, distilled water. Add the rinse water to the flask and dilute to the mark with deionized, distilled water; mix thoroughly. Pipette a 25-ml aliquot into the procelain evaporating dish. Return any unused portion of the sample to the polyethylene storage bottle. Evaporate the 25-ml aliquot to dryness on a steam bath and allow to cool. Add 2 ml phenoldisulfonic acid solution to the dried residue and triturate thoroughly with a polyethylene policeman. Make sure the solution contacts all the residue. Add 1 ml deionized, distilled water and four drops of concentrated sulfuric acid. Heat the solution on a steam bath for 3 minutes with occasional stirring. Allow the solution to cool, add 20 ml, or more, deionized, distilled water, mix well by stirring, and add concentrated ammonium hydroxide, dropwise, with constant stirring, until the pH is 10 (as determined by pH paper).

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If the sample contains solids these must be removed by filtration (centrifugation is an acceptable alternative, subject to the approval of the Control Agency's Authorized Representative), as follows: filter through Whatman No. 41 filter paper into a 100-ml volumetric flask, rinse the evaporating dish with three, approximately, 5-ml portions of deionized, distilled water; filter these three rinses. Wash the filter with at least three 15-ml portions of deionized, distilled water. Add the filter washings to the contents of the volumetric flask and dilute to the mark with deionized, distilled water. If solids are absent, the solution can be transferred directly to the 100-ml volumetric flask and diluted to the mark with deionized, distilled water. Mix the contents of the flask thoroughly, and measure the absorbance at the optimum wavelength used for the standards (Section 5.2.1), using the blank solution as a zero reference. Dilute the sample and the blank with equal volumes of deionized, distilled water if the absorbance exceeds A_4, the absorbance of the 400 ug NO_2 standard (see Section 5.2.2).

5. Calibration

5.1 Flask Volume. The volume of the collection flask-flask valve combination must be known prior to sampling. Assemble the flask and flask valve and fill with water, to the stopcock. Measure the volume of water to $\pm$10 ml. Record this volume on the flask.

5.2 Spectrophotometer Calibration.

5.2.1 Optimum Wavelength Determination. Calibrate the wavelength scale of the spectrophotometer every 6 months. The calibration may be accomplished by using an energy source with an intense line emission such as a mercury lamp, or by using a series of glass filters spanning the measuring range of the spectrophotometer. Calibration materials are available commercially and from the National Bureau of Standards. Specific details on the use of such materials should be supplied by the vendor; general information about calibration techniques can be obtained from general reference books on analytical chemistry. The wavelength scale of the spectrophotometer must read correctly within $\pm$ 5 nm at all calibration points; otherwise, the spectrophotometer shall be repaired and recalibrated. Once the wavelength scale of the spectrophotometer is in proper calibration, use 410 nm as the optimum wavelength for the measurement of the absorbance of the standards and samples.

Alternatively, a scanning procedure may be employed to determine the proper measuring wavelength. If the instrument is a double-beam spectrophotometer, scan the spectrum between 400 and 415 nm using a 200 ug NO_2 standard solution in the sample cell and a blank solution in the reference cell. If a peak does not occur, the

5.2 Spectrophotometer Calibration.

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Alternatively, a scanning procedure may be employed to determine the proper measuring wavelength. If the instrument is a double-beam spectrophotometer, scan the spectrum between 400 and 415 nm using a 200 ug NO_2 standard solution in the sample cell and a blank solution in the reference cell. If a peak does not occur, the

spectrophotometer is probably malfunctioning and should be repaired. When a peak is obtained within the 400 to 415 range, the wavelength at which this peak occurs shall be the optimum wavelength for the measurement of absorbance of both the standards and the samples. For a single-beam spectrophotometer, follow the scanning procedure described above, except that the blank and standard solutions shall be scanned separately. The optimum wavelength shall be the wavelength at which the maximum difference in absorbance between the standard and the blank occurs.

5.2.2 Determination of Spectrophotometer Calibration Factor K_c. Add 0.0 ml, 2 ml, 4 ml, 6 ml, and 8 ml of the KNO_2 working standard solution (1 ml = 100 ug NO_2) to a series of five 50-ml volumetric flasks. To each flask, add 25 ml of absorbing solution, 10 ml deionized, distilled water, and sodium hydroxide (1 N) dropwise until the pH is between 9 and 12 (about 25 to 35 drops each). Dilute to the mark with deionized, distilled water. Mix thoroughly and pipette a 25-ml aliquot of each solution into a separate procelain evaporating dish. Beginning with the evaporation step, follow the analysis procedure of Section 4.3, until the solution has been transferred to the 100 ml volumetric flask and diluted to the mark. Measure the absorbance of each solution, at the optimum

wavelength, as determined in Section 5.2.1. This calibration procedure must be repeated on each day that samples are analyzed. Calculate the spectrophotometer calibration factor as follows:

$$K_c = 100 \quad \frac{A_1 + 2A_2 + 3A_3 + 4A_4}{A_1^2 + A_2^2 + A_3^2 + A_4^2}$$

Equation 7-1

where:

K_c = Calibration factor

A_1 = Absorbance of the 100-ug NO_2 standard

A_2 = Absorbance of the 200-ug NO_2 standard

A_3 = Absorbance of the 300-ug NO_2 standard

A_4 = Absorbance of the 400-ug NO_2 standard

5.3 Barometer. Calibrate against a mercury barometer.

5.4 Temperature Gauge. Calibrate dial thermometers against mercury-in-glass thermometers.

5.5 Vacuum Gauge. Calibrate mechanical gauges, if used, against a mercury manometer such as that specified in 2.1.6.

5.6 Analytical Balance. Calibrate against standard weights.

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6. Calculation

Carry out the calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

6.1 Nomenclature

A = Absorbance of sample.

C = Concentration of NO_x as NO_2, dry basis corrected to standard conditions, mg/dscm (lb/dscf).

F = Dilution factor (i.e., 25/5, 25/10, etc., required only if sample dilution was needed to reduce the absorbance into the range of calibration).

K_c = Spectrophotometer calibration factor.

m = Mass of NO_x as NO_2 in gas sample, ug.

P_f = Final absolute pressure of flask, mm Hg (in. Hg).

P_i = Initial absolute pressure, 760 mm Hg (29.92 in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

T_f = Final absolute temperature of flask, ^oK (^oR).

T_i = Initial absolute temperature of flask, ^oK (^oR).

T_{std} = Standard absolute temperature, 293^oK (528^oR).

V_{sc} = Sample volume at standard conditions (dry basis), ml.

V_f = Volume of flask and valve, ml.

V_a = Volume of absorbing solution, 25 ml.

2 = 50/25, the aliquot factor. (If other than a 25 ml aliquot was used for analysis, the corresponding factor must be substituted.)

6.2 Sample volume, dry basis, corrected to standard conditions.

$$V_{sc} = \frac{T_{std}}{P_{std}} (V_f - V_a) \left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$

$$= K_1 (V_f - 25 \text{ ml}) \left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$

Equation 7-2

where

K_1 = $0.3858 \frac{^oK}{\text{mm Hg}}$ for metric units

= $17.64 \frac{^oR}{\text{in. Hg}}$ for English units

6.3 Total ug NO_2 Per Sample.

$$m = 2K_c \, AF$$

Equation 7-3

Note: If other than a 25-ml aliquot is used for analysis, the factor 2 must be replaced by a corresponding factor.

6.4 Sample concentration, dry basis, corrected to standard conditions.

$$C = K_2 \frac{m}{V_{sc}}$$

Equation 7-4

where

K_2 = $10^3 \frac{\text{mg/m}^3}{\text{ug/ml}}$ for metric units

= $6.243 \times 10^{-5} \frac{\text{lb/scf}}{\text{ug/ml}}$ for English units

6.2 Sample volume, dry basis, corrected to standard conditions.

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METHOD 8 - DETERMINATION OF SULFURIC ACID MIST AND SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle: A gas sample is extracted isokinetically from the stack. The sulfuric acid mist (including sulfur trioxide) and the sulfur dioxide are separated, and both fractions are measured separately by the barium-thorin titration method.

1.2 Applicability: This method is applicable for the determination of sulfuric acid mist (including sulfur trioxide, and in the absence of other particulate matter) and sulfur dioxide emissions from stationary sources. Collaborative tests have shown that the minimum detectable limits of the method are 0.05 milligrams/cubic meter (0.03×10^{-7} pounds/cubic foot) for sulfur trioxide and 1.2 mg/m^3 (0.74×10^{-7} lb/ft^3) for sulfur dioxide. No upper limits have been established. Based on theoretical calculations for 200 milliliters of 3 percent hydrogen peroxide solution, the upper concentraton limit for sulfur dioxide in a 1.0 m^3 (35.3 ft^3) gas sample is about 12,500 mg/m^3 (7.7×10^{-4} lb/ft^3). The upper limit can be extended by increasing the quantity of peroxide solution in the impingers.

Possible interfering agents of this method are fluorides, free ammonia, and dimethyl aniline. If any of these interfering agents are present (this can be determined by knowledge of the process), alternative methods, subject to the approval of the Control Agency's authorized representative, are required.

Filterable particulate matter may be determined along with SO_3 and SO_2 (subject to the approval of the Control Agency's authorized representative) by inserting a heated glass fiber filter between the probe and isopropanol impinger (see Section 2.1 of Method 6). If this option is chosen, particulate analysis is gravimetric only; H_2SO_4 acid mist is not determined separately.

2. Apparatus

2.1 Sampling: A schematic of the sampling train used in this method is shown in Figure 8-1; it is similar to the Method 5 train except that the filter position is different and the filter holder does not have to be heated. Commercial models of this train are available. For those who desire to build their own, however, complete construction details are described in APTD-0581. Changes from the APTD-0581 document and allowable modifications to Figure 8-1 are discussed in the following subsections.

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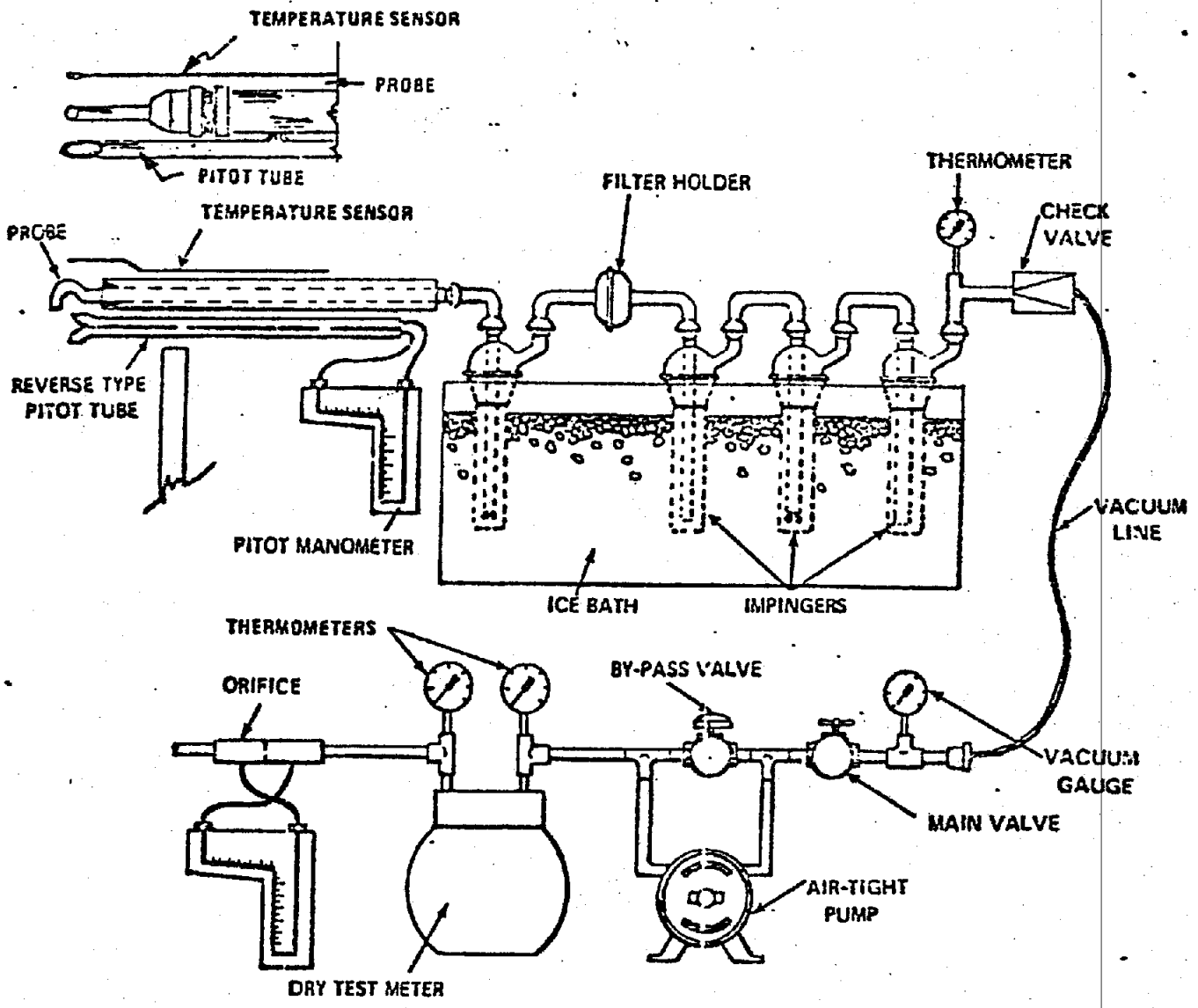

Figure 8-1. Sulfuric acid mist sampling train.

The operating and maintenance procedures for the sampling train are described in APTD-0576. Since correct usage is important in obtaining valid results, all users should read the APTD-0576 document and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. Further details and guidelines on operation and maintenance are given in Method 5 and should be read and followed whenever they are applicable.

2.1.1 Probe Nozzle: Same as Method 5, Section 2.1.1.

2.1.2 Probe Liner: Borosilicate or quartz glass, with a heating system to prevent visible condensation during sampling. Do not use metal probe liners.

2.1.3 Pitot Tube: Same as Method 5, Section 2.1.3.

2.1.4 Differential Pressure Gauge: Same as Method 5, Section 2.1.4

2.1.5 Filter Holder: Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other gasket materials, e.g., Teflon or Viton, may be used subject to the approval of the Control Agency's authorized representative. The holder design shall provide a positive seal against leakage from the outside or around

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2.1.5 Filter Holder: Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other gasket materials, e.g., Teflon or Viton, may be used subject to the approval of the Control Agency's authorized representative. The holder design shall provide a positive seal against leakage from the outside or around

the filter. The filter holder shall be placed between the first and second impingers. Note: Do not heat the filter holder.

2.1.6 Impingers - Four, as shown in Figure 8-1: The first and third shall be of the Greenburg-Smith design with standard tips. The second and fourth shall be of the Greenburn-Smith design, modified by replacing the insert with an approximately 13 millimeter (0.5 in.) ID glass tube, having an unconstricted tip located 13 mm (0.5 in.) from the bottom of the flask. Similar collection systems, which have been approved by the Control Agency's authorized representative may be used.

2.1.7 Metering System: Same as Method 5, Section 2.1.8.

2.1.8 Barometer: Same as Method 5, Section 2.1.9.

2.1.9 Gas Density Determination Equipment: Same as Method 5, Section 2.1.10.

2.1.10 Temperature Gauge: Thermometer, or equivalent, to measure the temperature of the gas leaving the impinger train to within 1°C (2°F).

2.2 Sample Recovery.

2.2.1 Wash Bottles: Polyethylene or glass, 500 ml (two).

2.2.2 Graduated Cylinders: 250 ml, 1 liter. (Volumetric Flasks may also be used.)

2.2.3 Storage Bottles: Leak-free polyethylene bottles, 1000 ml size (two for each sampling run).

2.2.4 Trip Balance: 500-gram capacity, to measure to ±0.5 g (necessary only if a moisture content analysis to be be done).

2.3 Analysis

2.3.1 Pipettes: Volumetric 25 ml, 100 ml.

2.3.2 Burette: 50 ml.

2.3.3 Erlenmeyer Flask: 250 ml, (one for each sample blank and standard).

2.3.4 Graduated Cylinder: 100 ml.

2.3.5 Trip Balance: 500 g capacity, to measure to ±0.5 g.

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2.2.1 Wash Bottles: Polyethylene or glass, 500 ml (two).

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2.3.3 Erlenmeyer Flask: 250 ml, (one for each sample blank and standard).

2.3.4 Graduated Cylinder: 100 ml.

2.3.5 Trip Balance: 500 g capacity, to measure to ±0.5 g.

2.3.6 Dropping Bottle: To add indicator solution, 125-ml size.

3. Reagents

Unless otherwise indicated, all reagents are to conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Otherwise, use the best available grade.

3.1 Sampling.

3.1.1 Filters: Same as Method 5, Section 3.1.1.

3.1.2 Silica Gel: Same as Method 5, Section 3.1.2.

3.1.3 Water: Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentratons of organic matter are not expected to be present.

3.1.4 Isopropanol: 80 Percent. Mix 800 ml of isopropanol with 200 ml of deionized, distilled water.

Note: Experience has shown that only A.C.S. grade isopropanol is satisfactory. Tests have shown that isopropanol obtained from commercial sources occasionally

has peroxide impurities that will cause erroneously high sulfuric acid mist measurement. Use the following test for detecting peroxides in each lot of isopropanol: Shake 10 ml of the isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of distilled water. After 1 minute, read the absorbance on a spectrophotometer at 352 nanometers. If the absorbance exceeds 0.1, the isopropanol shall not be used. Peroxides may be removed from isopropanol by redistilling, or by passage through a column of activated alumina. However, reagent-grade isopropanol with suitably low peroxide levels is readily available from commercial sources; therefore, rejection of contaminated lots may be more efficient than following the peroxide removal procedure.

3.1.5 Hydrogen Peroxide, 3 Percent: Dilute 100 ml of 30 percent hydrogen peroxide to 1 liter with deionized, distilled water. Prepare fresh daily.

3.1.6 Crushed ice.

3.2 Sample Recovery.

3.2.1 Water: Same as 3.1.3.

has peroxide impurities that will cause erroneously high sulfuric acid mist measurement. Use the following test for detecting peroxides in each lot of isopropanol: Shake 10 ml of the isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of distilled water. After 1 minute, read the absorbance on a spectrophotometer at 352 nanometers. If the absorbance exceeds 0.1, the isopropanol shall not be used. Peroxides may be removed from isopropanol by redistilling, or by passage through a column of activated alumina. However, reagent-grade isopropanol with suitably low peroxide levels is readily available from commercial sources; therefore, rejection of contaminated lots may be more efficient than following the peroxide removal procedure.

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3.1.6 Crushed ice.

3.2 Sample Recovery.

3.2.1 Water: Same as 3.1.3.

3.2.2 Isopropanol, 80 Percent: Same as 3.1.4.

3.3 Analysis

3.3.1 Water: Same as 3.1.3.

3.3.2 Isopropanol, 100 Percent.

3.3.3 Thorin Indicator: 1-(o-arsonophenylazo)-2-naphthol-3, 6-disulfonic acid, disodium salt, or equivalent. Dissolve 0.20 g in 100 ml of deionized, distilled water.

3.3.4 Barium Perchlorate (0.0100 Normal): Dissolve 1.95 g of barium perchlorate trihydrate [$Ba(ClO_4)_2 \cdot 3H_2O$] in 200 ml deionized, distilled water, and dilute to 1 liter with isopropanol; 1.22 g of barium chloride dihydrate ($BaCl_2 \cdot 2H_2O$) may be used instead of the barium perchlorate. Standardize with sulfuric acid as in Section 5.2. This solution must be protected against evaporation at all times.

3.3.5 Sulfuric Acid Standard (0.0100 N): Purchase or standardize to $\pm$0.0002 N against 0.0100 N NaOH that has previously been standardized against primary standard potassium acid phthalate.

4. Procedure

4.1 Sampling

4.1.1 Pretest Preparation: Follow the procedure outlined in Method 5, Section 4.1.1; filters should be inspected, but need not be desiccated, weighed, or identified. If the effluent gas can be considered dry, i.e., moisture free, the silica gel need not be weighed.

4.1.2 Preliminary Determinations: Follow the procedure outlined in Method 5, Section 4.1.2.

4.1.3 Preparation of Collection Train: Follow the procedure outlined in Method 5, Section 4.1.3 (except for the second paragraph and other obviously inapplicable parts) and use Figure 8-1 instead of Figure 5-1. Replace the second paragraph with: Place 100 ml of 80 percent isopropanol in the first impinger, 100 ml of 3 percent hydrogen peroxide in both the second and third impingers; retain a portion of each reagent for use as a blank solution. Place about 200 g of silica gel in the fourth impinger.

Note: If moisture content is to be determined by impinger analysis, weigh each of the first three impingers (plus absorbing solution) to the nearest 0.5 g and record these weights. The weight of the silica gel (or silica gel plus

4. Procedure

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Note: If moisture content is to be determined by impinger analysis, weigh each of the first three impingers (plus absorbing solution) to the nearest 0.5 g and record these weights. The weight of the silica gel (or silica gel plus

container) must also be determined to the nearest 0.5 g and recorded.

4.1.4 Pretest Leak-Check Procedure: Follow the basic procedure outlined in Method 5, Section 4.1.4.1, noting that the probe heaters hall be adjusted to the minimum temperature required to prevent condensation, and also that verbage such as, "plugging the inlet to the filter holder...," shall be replaced by, "...-plugging the inlet to the first impinger."

4.1.5 Train Operation: Follow the basic procedure outlined in Method 5, Section 4.1.5, in conjunction with the following special instructions. Data shall be recorded on a sheet similar to the one in Figure 8-2. The sampling rate shall not exceed 0.030m^3/min (1.0 cfm) during the run. Periodically during the test, observe the connecting line between the probe and first impinger for signs of condensation. If it does occur, adjust the probe heater setting upward to the minimum temperature required to prevent condensation. If component changes become necessary during a run, a leak-check shall be done immediately before each change, according to the procedure outlined in Section 4.1.4.2 of Method 5 (with appropriate modifications, as mentioned in Section 4.1.4 of this

FIELD DATA

Ambient Temp $^{\circ}F$ ______________

Bar. Press."Hg ______________

Run No. ______________

Location ______________

Date ______________

Operator ______________

Sample Box No. ______________

Meter Box No. ______________

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

Leak Test = Before ______ After ______

Pitot Tube Factor ______________

Assumed Moisture % ______________

Heater Box Setting, $^{\circ}F$ ______________

Probe Tip Dia., In. ______________

Probe Length ______________

Probe Heater Setting ______________

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. $^{\circ}F$		Pump Vacuum In. Hg Gauge	Impinger Temp $^{\circ}F$	Stack Press In. Hg	Stack Temp $^{\circ}F$
				Desired	Actual	Inlet	Outlet				

Figure 8-[illegible] Field Data

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FIELD DATA

Run No. ____________

Location ____________

Date ____________

Operator ____________

Sample Box No. ____________

Meter Box No. ____________

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

Leak Test = Before ______ After ______

Pitot Tube Factor ____________

Ambient Temp °F ____________

Bar. Press."Hg ____________

Assumed Moisture % ____________

Heater Box Setting, °F ____________

Probe Tip Dia., In. ____________

Probe Length ____________

Probe Heater Setting ____________

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. °F		Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F
				Desired	Actual	Inlet	Outlet				

Figure 8 Field Data

method); record all leak rates. If the leakage rate(s) exceed the specified rate, the tester shall either void the run or shall plan to correct the sample volume as outlind in Section 6.3 of Method 5. Immediately after component changes, conduct leak-checks per the procedure outlined in Section 4.1.4.1 of Method 5 (with appropriate modifications).

After turning off the pump and recording the final readings at the conclusion of each run, remove the probe from the stack. Conduct a post-test (mandatory) leak-check as in Section 4.1.4.3 of Method 5 (with appropriate modification) and record the leak rate. If the post-test leakage rate exceeds the specified acceptable rate, the tester shall either correct the sample volume, as outlined in Section 6.3 of Method 5, or shall void the run.

Drain the ice bath and, with the probe disconnected, purge the remaining part of the train, by drawing clean ambient air through the system for 15 minutes at the average flow rate used for sampling.

Note: Clean ambient air can be provided by passing air through a charcoal filter. At the option of the tester, ambient air (without cleaning) may be used.

4.1.6 Calculation of Percent Isokinetic: Follow the procedure outlined in Method 5, Section 4.1.6.

4.2 Sample Recovery

4.2.1 Container No. 1: If a moisture content analysis is to be done, weigh the first impinger plus contents to the nearest 0.5 g and record this weight.

Transfer the contents of the first impinger to a 250-ml graduated cylinder. Rinse the probe, first impinger, all connecting glassware before the filter, and the front half of the filter holder with 80 percent isopropanol. Add the rinse solution to the cylinder. Dilute to 250 ml with 80 percent isopropanol. Add the filter to the solution, mix, and transfer to the storage container. Protect the solution against evaporation. Mark the level of liquid on the container and identify the sample container.

4.2.2 Container No. 2: If a moisture content analysis is to be done, weigh the second and third impingers (plus contents) to the nearest 0.5 g and record these weights. Also, weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

4.1.6 Calculation of Percent Isokinetic: Follow the procedure outlined in Method 5, Section 4.1.6.

4.2 Sample Recovery

4.2.1 Container No. 1: If a moisture content analysis is to be done, weigh the first impinger plus contents to the nearest 0.5 g and record this weight.

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4.2.2 Container No. 2: If a moisture content analysis is to be done, weigh the second and third impingers (plus contents) to the nearest 0.5 g and record these weights. Also, weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

Transfer the solutions from the second and third impingers to a 1000-ml graduated cylinder. Rinse all connecting glassware (including back half of filter holder) between the filter and silica gel impinger with deionized, distilled water, and add this rinse water to the cylinder. Dilute to a volume of 1000 ml deionized, distilled water. Transfer the solution to a storage container. Mark the level of liquid on the container. Seal and identify the sample container.

4.3 Analysis

Note the level of liquid in containers 1 and 2, and confirm whether or not any sample was lost during shipment; note this on the analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Control Agency's authorized representative, to correct the final results.

4.3.1 Container No. 1: Shake the container holding the isopropanol solution and the filter. If the filter breaks up, allow the fragments to settle for a few minutes before removing a sample. Pipette a 100-ml aliquot of this solution into a 250-ml Erlenmeyer flask, add 2 to 4 drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat the titration with a second aliquot of sample and average the titration

values. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is greater.

4.3.2 Container No. 2: Thoroughly mix the solution in the container holding the contents of the second and third impingers. Pipette a 10-ml aliquot of sample into a 250-ml Erlenmeyer flask. Add 40 ml of isopropanol, 2 to 4 drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat the titration with a second aliquot of sample and average the titration values. Replicate titrations must agree within 1 prcent or 0.2 ml, whichever is greater.

4.3.3 Blanks: Prepare blanks by adding 2 to 4 drops of thorin indicator to 100 ml of 80 percent isopropanol. Titrate the blanks in the same manner as the samples.

5. Calibration

5.1 Calibrate equipment using the procedures specified in the following sections of Method 5: Section 5.3 (metering system); Section 5.5 (temperature gauges); Section 5.7 (barometer). Note that the recommended leak-check of the metering system, described in Section 5.6 of Method 5, also applies to this method.

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5.2 Standardize the barium perchlorate solution with 25 ml of standard sulfuric acid to which 100 ml of 100 percent isopropanol has been added.

6. Calculations

Note: Carry out calculations retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

6.1 Nomenclature

A = Cross sectional area of nozzle, m^2, (ft^2).

B_{ws} = Water vapor in the gas stream, proportion by volume.

$C_{H_2SO_4}$ = Sulfuric acid (including SO_2) concentration, g/dscm (lb/dscf).

C_{SO_2} = Sulfur dioxide concentration, g/dscm (lb/dscf).

I = Percent of isokinetic sampling.

N = Normality of barium perchlorate titrant, g equivalents/liter.

P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).

P_s = Absolute stack gas pressure, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

T_m = Average absolute dry gas meter temperature (see Figure 8-2), ^oK (^oR).

T_s = Average absolute stack gas temperature (see Figure 8-2), ^oK (^oR).

T_{std} = Standard absolute temperature, 293°K (528°R).

V_a = Volume of sample aliquot titrated, 100 ml for H_2SO_4 and 10 ml for SO_2.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml.

V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).

$V_m(std)$ = Volume of gas sample measure by the dry gas meter corrected to standard conditions, dscm (dscf).

v_s = Average stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 8, m/sec (ft/sec).

V_{soln} = Total volume of solution in which the sulfuric acid or sulfur dioixde sample is contained, 250 ml or 1,000 ml, respectively.

V_t = Volume of barium perchlorate titrant used for the sample, ml.

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

Y = Dry gas meter calibration factor.

ΔH = Average pressure drop across orifice meter, mm (in.) H_2O.

θ = Total sampling time, min.

13.6 = Specific gravity of mercury.

60 = sec/min.

100 = Conversion to percent

T_{std} = Standard absolute temperature, 293°K (528°R).

V_a = Volume of sample aliquot titrated, 100 ml for H_2SO_4 and 10 ml for SO_2.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml.

V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).

$V_m(std)$ = Volume of gas sample measure by the dry gas meter corrected to standard conditions, dscm (dscf).

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ΔH = Average pressure drop across orifice meter, mm (in.) H_2O.

θ = Total sampling time, min.

13.6 = Specific gravity of mercury.

60 = sec/min.

100 = Conversion to percent

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 8-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C and 760 mm Hg or 68°F and 29.92 in. Hg) by using Equation 8-1.

$$V_{m(std)} = V_m Y \frac{P_{bar} + (\Delta H/13.6)}{P_{std}}$$

$$= K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 8-1

where:

K_1 = 0.3858 °K/mm Hg for metric units.

17.65 °R/in. Hg for English units.

Note: If the leak rate observed during any mandatory leak-checks exceeds the specified acceptable rate, the tester shall either correct the value of V_m in Equation 8-1 (as described in Section 6.3 of Method 5), or shall invalidate the test run.

6.4 Volume of Water Vapor and Moisture Content. Calculate the volume of water vapor using Equation 5-2 of Method 5; the weight of water collected in the impingers and silica gel can be directly converted to milliliters (the specific gravity of water is 1 g/ml). Calculate

the moisture content of the stack gas, using Equation 5-3 of Method 5. The "Note" in Section 6.5 of Method 5 also applies to this method. Note that if effluent gas stream can be considered dry, the volume of water vapor and moisture content need not be calculated.

6.5 Sulfuric acid mist (including SO_3) concentration.

$$C_{H_2SO_4} = K_2 N \frac{(V_t - V_{tb})(V_{soln}/V_a)}{V_m\ (std)}$$

Equation 8-2

where

K_2 = 0.04904 g/milliequivalent for metric units.

= 1.081×10^{-4} lb/meq for English units.

6.6 Sulfur dioxide concentraton.

$$C_{SO_2} = K_3 N \frac{(V_t - V_{tb})(V_{soln}/V_a)}{V_m\ (std)}$$

Equation 8-3

where

K_3 = 0.03203 g/meq for metric units.

= 7.061×10^{-5} lb/meq for English units.

the moisture content of the stack gas, using Equation 5-3 of Method 5. The "Note" in Section 6.5 of Method 5 also applies to this method. Note that if effluent gas stream can be considered dry, the volume of water vapor and moisture content need not be calculated.

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Equation 8-3

where

K_3 = 0.03203 g/meq for metric units.

= 7.061×10^{-5} lb/meq for English units.

6.7 Isokinetic Variation.

6.7.1 Calculation from raw data

$$I = \frac{100\ T_s\ [K_4\ V_{lc} + V_m\ Y/T_m)\ (P_{bar} + \Delta H/13.6)]}{60\ \theta\ v_s\ P_s\ A_n}$$

Equation 8-4

where

K_4 = 0.003464 mm Hg m^3/ml ^oK for metric units.

= 0.002676 in. Hg ft^3/ml ^oR for English units.

6.7.2 Calculation from intermediate values.

$$I = \frac{T_s\ V_{m(std)}\ P_{std}\ 100}{T_{std}\ v_s\ \theta\ A_n\ P_s\ 60\ (1 - B_{ws})}$$

$$= K_5\ \frac{T_s\ V_{m(std)}}{P_s\ v_s\ A_n\ \theta\ (1 - B_{ws})}$$

Equation 8-5

where:

K_5 = 4.320 for metric units.

= 0.09450 for English units.

6.8 Acceptable Results. If $\leq$90 percent $I \leq$ 110 percent, the results are acceptable. If the results are low in comparison to the standards and I is beyond the acceptable range, the Administrator may opt to accept the results. Use Citation 4 in the Bibliography of Method 5 to make judgements. Otherwise, reject the results and repeat the test.

7. Bibliography

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3. Martin, Robert M. Construction Details of Isokinetic Source Sampling Equipment. Environmental Protection Agency. Research Triangle Park, NC. Air Pollution Control Office Publication No. APTD-0581. April 1971.

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5. Rom, J.J. Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment. Office of Air Programs, Environmental Protection Agency. Research Triangle Park, NC. APTD-0576. March 1972.

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1. Atmospheric Emissions from Sulfur Acid Manufacturing Processes. U.S. DHEW, PHS, Division of Air Pollution. Public Health Service Publication No. 999-AP-13. Cincinnati, Ohio. 1965.

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METHOD 10 - DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle: An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a nondispersive infrared analyzer (NDIR) or equivalent.

1.1 Applicability: This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. The test procedure will indicate whether a continuous or an integrated sample is to be used.

2. Range and Sensitivity

2.1 Range: 0 to 1,000 ppm.

2.2 Sensitivity: Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. Interferences

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water

(H_2O) and carbon dioxide (CO_2) are 3.5 percent H_2O per 7 ppm CO and 10 percent CO_2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H_2O per 25 ppm CO and 10 percent CO_2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. Precision and Accuracy

4.1 Precision: The precision of most NDIR analyzers is approximately ±2 percent of span.

4.2 Accuracy: The accuracy of most NDIR analyzers is approximately ±5 percent of span after calibration.

5. Apparatus

5.1 Continuous Sample (Figure 10-1).

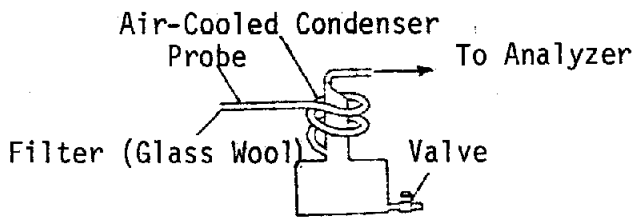

Figure 10-1. Continuous sampling train.

5.1.1 Probe: Stainless steel or sheathed borosilicate or quartz glass, equipped with a filter to remove particulate matter.

(H_2O) and carbon dioxide (CO_2) are 3.5 percent H_2O per 7 ppm CO and 10 percent CO_2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H_2O per 25 ppm CO and 10 percent CO_2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. Precision and Accuracy

4.1 Precision: The precision of most NDIR analyzers is approximately ±2 percent of span.

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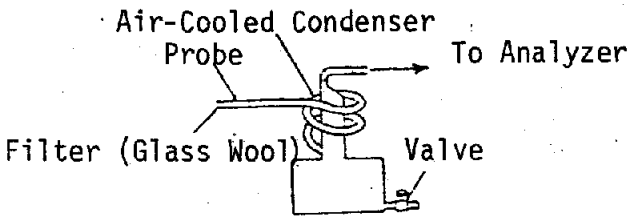

Figure 10-1. Continuous sampling train.

5.1.1 Probe: Stainless steel or sheathed borosilicate or quartz glass, equipped with a filter to remove particulate matter.

5.1.2 Air-cooled Condenser or Equivalent: To remove any excess moisture.

5.1.3 Sample Line: Line shall be made of Teflon, and if necessary, insulated and capable of being heated to a minimum of 120°C. If condensation is not a problem, sample line does not have to be heated. Alternatively, sample line made from other material (equivalent or better) may be used subject to the approval of the Control Agency's Authorized Representative.

5.2 Integrated sample (Figure 10-2).

5.2.1 Probe. Stainless steel or sheathed borosilicate or quartz glass, equipped with a filter to remove particulate matter.

5.2.2 Air cooled condenser or equivalent. To remove any excess moisture.

5.2.3 Valve. Needle valve, or equivalent, to adjust flow rate.

5.2.4 Pump. Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 Rate Meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min. (0.035 cfm).

5.2.6 Flexible Bag: Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft.^{3}). Leak-test the bag in the laboratory before using by evacuating bag with a pump followed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

5.2.7 Pitot Tube: Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with the time or a sample traverse is conducted.

5.2.8 Sample Line: (See Section 5.1.3).

5.3 Analysis (Figure 10-3)

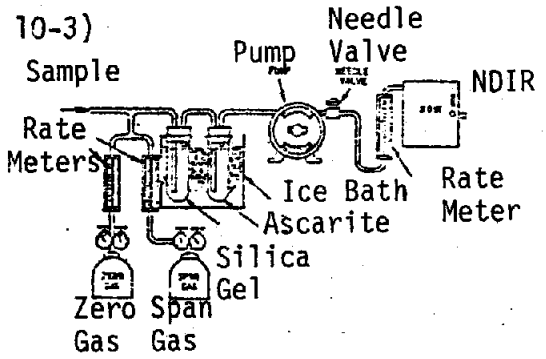

Figure 10-3. Analytical equipment

5.3.1 Carbon Monoxide Analyzer: Nondispersive infrared spectrometer, or equivalent. This instrument should be demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method or Method 100.

5.3.2 Drying Tube: To contain approximately 200 g of silica gel. Acceptable alternatives would include the refrigeration system specified under Method 100 (Section 2.1.4) or other types of desiccants (equivalent or better), subject to the approval of the Control Agency's Authorized Representative.

5.3.3 Calibration Gas: Refer to paragraph 6.1.

5.3.4 Filter: As recommended by NDIR manufacturer.

5.3.5 CO_2 Removal Tube: To contain approximately 500 g of ascarite. Alternatively, other methods of CO_2 interference elimination (equivalent or better) may be used, subject to the approval of the Control Agency's Authorized Representative. Acceptable methods would be an analyzer with a filter or electronic signal conditioning to correct CO_2 interference.

5.3.6 Ice Water Bath: For ascarite and silica get tubes, if used.

5.3.7 Valve: Needle valve, or equivalent, to adjust flow rate.

5.3.8 Rate Meter: Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min. (0.035 cfm) through NDIR.

5.3.2 Drying Tube: To contain approximately 200 g of silica gel. Acceptable alternatives would include the refrigeration system specified under Method 100 (Section 2.1.4) or other types of desiccants (equivalent or better), subject to the approval of the Control Agency's Authorized Representative.

5.3.3 Calibration Gas: Refer to paragraph 6.1.

5.3.4 Filter: As recommended by NDIR manufacturer.

5.3.5 CO_2 Removal Tube: To contain approximately 500 g of ascarite. Alternatively, other methods of CO_2 interference elimination (equivalent or better) may be used, subject to the approval of the Control Agency's Authorized Representative. Acceptable methods would be an analyzer with a filter or electronic signal conditioning to correct CO_2 interference.

5.3.6 Ice Water Bath: For ascarite and silica get tubes, if used.

5.3.7 Valve: Needle valve, or equivalent, to adjust flow rate.

5.3.8 Rate Meter: Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min. (0.035 cfm) through NDIR.

5.3.9 Recorder (optional): To provide permanent record of NDIR readings.

6. Reagents

6.1 Calibration Gases

Zero Gas: Pure air or nitrogen with less than 1 ppm of CO.

Span Gas: The calibration gas shall be approximately 70-80 percent of the analyzer range but not more than 150 percent of the applicable source performance standard unless exceeded by the source. The expected maximum concentration to be measured should not be more than 90 percent of the analyzer range. The calibration gas shall be traceable to the National Bureau of Standards primary standard gas blend. Known concentration of CO in nitrogen (N_2) for instrument span, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ± 2 percent of the specified concentration.

6.2 Silica Gel: Indicating type, 6 to 16 mesh, dried at 175°C (350°F) for 2 hours.

6.3 Ascarite: Commercially available.

7. Procedure

7.1 Sampling:

7.1.1 Continuous Sampling: Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and probe the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See paragraphs 7.2 and 8.) CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated Sampling: Evacuate the flexible bag. Set up the equipment as shown in Figure 10-3 with the bag disconnected.

Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7. Procedure

7.1 Sampling:

7.1.1 Continuous Sampling: Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and probe the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See paragraphs 7.2 and 8.) CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated Sampling: Evacuate the flexible bag. Set up the equipment as shown in Figure 10-3 with the bag disconnected.

Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.2 CO Analysis: Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in paragraph 8. Purge analyzer with N_2 prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

8. Calibration

Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of one hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO_2 removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen or zero grade air and the calibration gases.

9. Calculation - Concentration of Carbon Monoxide: Calculate the concentration of carbon monoxide in the stack using Equation 10-1.

$$C_{CO_{stack}} = C_{CO_{NDIR}} \quad (1-F_{CO_2})$$

Equation 10-1

where

$C_{CO_{stack}}$ = Concentration of CO in stack, ppm by volume (dry basis).

$C_{CO_{NDIR}}$ = Concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

F_{CO_2} = Volume fraction of CO_2 in sample, i.e., percent CO_2 from Orsat analysis divided by 100.

= 0 if CO_2 interference is eliminated by means other than CO_2 physical removal.

ADDENDA

A. Performance Specifications for NDIR Carbon Monoxide Analyzers

Range (minimum)	0-1000 ppm
Output (minimum)	0-10 mV
Minimum detectable sensitivity	20 ppm
Rise time, 90 percent (maximum)	30 seconds
Fall time, 90 percent (maximum)	30 seconds
Zero drift (maximum)	10% in 8 hours
Span drift (maximum)	10% in 8 hours
Precision (maximum)	± 2% of full scale
Noise (maximum)	± 1% of full scale
Linearity (maximum deviation)	2% of full scale
Interference rejection ratio	CO_2 - 1000 to 1, H_2O - 500 to 1

where

$C_{CO_{stack}}$ = Concentration of CO in stack, ppm by volume (dry basis).

$C_{CO_{NDIR}}$ = Concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

F_{CO_2} = Volume fraction of CO_2 in sample, i.e., percent CO_2 from Orsat analysis divided by 100.

= 0 if CO_2 interference is eliminated by means other than CO_2 physical removal.

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Span drift (maximum)	10% in 8 hours
Precision (maximum)	$\pm$ 2% of full scale
Noise (maximum)	$\pm$ 1% of full scale
Linearity (maximum deviation)	2% of full scale
Interference rejection ratio	CO_2 - 1000 to 1, H_2O - 500 to 1

B. Definitions of Performance Specifications

Range - The minimum and maximum measurement limits.

Output Electrical signal which is proportional to the measurement; intended for connection to readout of data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedance.

Full scale - The maximum measuring limit for a given range.

Minimum detectable sensitivity - The smallest amount of input concentration that can be detected as the concentration approaches zero.

Accuracy - The degree of agreement between a measured value and the true value; usually expressed as $\pm$ percent of full scale.

Time to 90 percent response - The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent) - The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

Fall Time (90 percent) - The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Span Drift - The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is a stated upscale value; usually expressed as percent full scale.

10. Bibliography

1. McElroy, Frank. The Intertech NDIR-CO Analyzer. Presented at 11th Methods Conference on Air Pollution, University of California, Berkeley, CA. April 1, 1970.

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5. Continuous CO Monitoring System, Model A5611, Intertech Corp., Princeton, N.J.

6. UNOR Infrared Gas Analyzers. Bendix Corporation, Ronceverte, West Virginia.

METHOD 11 - DETERMINATION OF HYDROGEN SULFIDE CONTENT OF FUEL GAS STREAMS IN PETROLEUM REFINERIES

1. Principle and Applicability.

1.1 Principle: Hydrogen sulfide (H_2S) is collected from a source in a series of midget impingers and absorbed in pH 3.0 cadmium sulfate ($CdSO_4$) solution to form cadmium sulfide (CdS). The latter compound is then measured iodometrically. An impinger containing hydrogen peroxide is included to remove SO_2 as an interfering species.

1.2 Applicability: This method is applicable for the determination of the hydrogen sulfide content of fuel gas streams at petroleum refineries.

2. Range and Sensitivity.

The lower limit of detection is approximately 8 mg/m^3 (6 ppm). The maximum of the range is 740 mg/m^3 (520 ppm).

3. Interferences

Any compound that reduces iodine or oxidizes iodide ion will interfere in this procedure, provided it is collected in the cadmium sulfate impingers. Sulfur dioxide in concentrations of up to 2,600 mg/m^3 is eliminated by the hydrogen peroxide solution. Thiols precipitate with

hydrogen sulfide. In the absence of H_2S, only co-traces of thiols are collected. When methane- and ethane-thiols at a total level of 300 mg/m^3 are present in addition to H_2S, the results vary from 2 percent low at an H_2S concentration of 400 mg/m^3 to 14 percent high at an H_2S concentration of 100 mg/m^3. Carbon oxysulfide at a concentration of 20 percent does not interfere. Certain carbonyl-containing compounds react with iodine and produce recurring end points. However, acetaldehyde and acetone at concentrations of 1 and 3 percent, respectively, do not interfere.

Entrained hydrogen peroxide produces a negative interference equivalent to 100 percent of that of an equimolar quantity of hydrogen sulfide. Avoid the ejection of hydrogen peroxide into the cadmium sulfate impingers.

4. Precision and Accuracy.

Collaborative testing has shown the within-laboratory coefficient of variation to be 2.2 percent and the overall coefficient of variation to be 5 percent. The method bias was shown to be -4.8 percent when only H_2S was present. In the presence of the interferences cited in Section 3, the bias was positive at low H_2S concentrations and negative at higher concentrations. At 230 mg H_2S/m^3, the level of the compliance standard, the bias was +2.7 percent. Thiols had no effect on the precision.

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Entrained hydrogen peroxide produces a negative interference equivalent to 100 percent of that of an equimolar quantity of hydrogen sulfide. Avoid the ejection of hydrogen peroxide into the cadmium sulfate impingers.

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5. Apparatus.

5.1 Sampling Apparatus.

5.1.1 Sampling Line. Six to 7 mm (1/4 in.) Teflon[1/] tubing to connect the sampling train to the sampling valve.

5.1.2 Impingers. Five midget impingers, each with 30 ml capacity. The internal diameter of the impinger tip must be 1 mm ±0.05 mm. The impinger tip must be positioned 4 to 6 mm from the bottom of the impinger.

5.1.3 Glass or Teflon connecting tubing for the impingers.

5.1.4 Ice bath container. To maintain absorbing solution at a low temperature.

5.1.5 Drying Tube. Tube packed with 6- to 16-mesh indicating-type silica gel, or equivalent, to dry the gas sample and protect the meter and pump. If the silica gel has been used previously, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to approval of the Control Agency's Authorized Representative.

1/. Mention of trade names of specific products does not constitute endorsement by the Air Resources Board.

Note - Do not use more than 30 g of silica gel. Silica gel absorbs gases such as propane from the fuel gas stream, and use of excessive amounts of silica gel could result in errors in the determination of sample volume.

5.1.6 Sampling Valve. Needle valve or equivalent to adjust gas flow rate. Stainless steel or other corrosion-resistant material.

5.1.7 Volume Meter. Dry gas meter, sufficiently accurate to measure the sample volume within 2 percent, calibrated at the selected flow rate (1.0 liter/min) and conditions actually encountered during sampling. The meter shall be equipped with a temperature gauge (dial thermometer or equivalent) capable of measuring temperature to within $3^{o}C$ ($5.4^{o}F$). The gas meter should have a petcock, or equivalent, on the outlet connector which can be closed during the leak check. Gas volume for one revolution of the meter must not be more than 10 liters.

5.1.8 Flow meter. Rotameter or equivalent, to measure flow rates in the range from 0.5 to 2 liters/min (1 to 4 cfh).

5.1.9 Graduated cylinder, 25-ml size.

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5.1.8 Flow meter. Rotameter or equivalent, to measure flow rates in the range from 0.5 to 2 liters/min (1 to 4 cfh).

5.1.9 Graduated cylinder, 25-ml size.

5.1.10 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby National Weather Service station, in which case, the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft.) elevation increase or vice-versa for elevation decrease.

5.1.11 U-tube Manometer. 0-30 cm water column. For leak check procedure.

5.1.12 Rubber squeeze bulb. To pressurize train for leak check.

5.1.13 Tee, pinchclamp, and connecting tubing. For leak check.

5.1.14 Pump. Diaphragm pump, or equivalent. Insert a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter. The pump is used for the air purge at the end of the sample run; the pump is not ordinarily used during sampling, because fuel gas streams are usually sufficiently pressurized to force sample gas through the

train at the required flow rate. The pump need not be leak-free unless it is used from sampling.

5.1.15 Needle valve or critical orifice. To set air purge flow to 1 liter/min.

5.1.16 Tube packed with active carbon. To filter air during purge.

5.1.17 Volumetric flask. One 1,000 ml.

5.1.18 Volumetric pipette. One 15 ml.

5.1.19 Pressure-reduction regulator. Depending on the sampling stream pressure, a pressure-reduction regulator may be needed to reduce the pressure of the gas stream entering the Teflon sample line to a safe level.

5.1.20 Cold trap. If condensed water or amine is present in the sample stream, a corrosion-resistant cold trap shall be used immediately after the sample tap. The trap shall not be operated below $0^{o}C$ ($32^{o}F$) to avoid condensation of C_3 or C_4 hydrocarbons.

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5.1.20 Cold trap. If condensed water or amine is present in the sample stream, a corrosion-resistant cold trap shall be used immediately after the sample tap. The trap shall not be operated below $0^{o}C$ ($32^{o}F$) to avoid condensation of C_3 or C_4 hydrocarbons.

5.2 Sample Recovery.

5.2.1 Sample container. Iodine flask, glass-stoppered: 500 ml size.

5.2.2 Pipette. 50 ml volumetric type.

5.2.3 Graduated cylinders. One each 25 and 250 ml.

5.2.4 Flasks. 125 ml, Erlenmeyer.

5.2.5 Wash bottle.

5.2.6 Volumetric flasks. Three 1,000 ml.

5.3 Analysis

5.3.1 Flask. 500 ml glass-stoppered iodine flask.

5.3.2 Burette. 50 ml.

5.3.3 Flask. 125 ml, Erlenmeyer.

5.3.4 Pipettes, volumetric. One 25 ml; two each 50 and 100 ml.

5.3.5 Volumetric flasks. One 1,000 ml; two 500 ml.

5.3.6 Graduated cylinders. One each 10 and 100 ml.

6. Reagents

Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Otherwise, use the best available grade.

6.1 Sampling.

6.1.1 Cadmium sulfate absorbing solution. Dissolve 41 g of $3CdSO_4 \cdot 8H_2O$ and 15 ml of 0.1 M sulfuric acid in a 1-liter volumetric flask that contains approximately 3/4 liter of deionized distilled water. Dilute to volume with deionized water. Mix thoroughly. pH should be 3 ± 0.1. Add 10 drops of Dow-Corning Antifoam B. Shake well before use. If Antifoam B is not used, the alternate acidified iodine extraction procedure (Section 7.2.2) must be used.

6.1.2 Hydrogen peroxide, 3 percent. Dilute 30 percent hydrogen peroxide to 3 percent as needed. Prepare fresh daily.

6.1.3 Water. Deionized, distilled to conform to ASTM specifications D1193-72, Type 3, at the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

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Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Otherwise, use the best available grade.

6.1 Sampling.

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6.1.2 Hydrogen peroxide, 3 percent. Dilute 30 percent hydrogen peroxide to 3 percent as needed. Prepare fresh daily.

6.1.3 Water. Deionized, distilled to conform to ASTM specifications D1193-72, Type 3, at the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

6.2 Sample Recovery.

6.2.1 Hydrochloric acid solution (HCl), 3M. Add 240 ml of concentrated HCl (specific gravity 1.19) to 500 ml of deionized, distilled water in a 1-liter volumetric flask. Dilute to 1 liter with deionized water. Mix thoroughly.

6.2.2 Iodine solution 0.1 N. Dissolve 24 g of potassium iodide (KI) in 30 ml of deionized, distilled water. Add 12.7 g of resublimed iodine (I_2) to the potassium iodide solution. Shake the mixture until the iodine is completely dissolved. If possible, let the solution stand overnight in the dark. Slowly dilute the solution to 1 liter with deionized, distilled water, with swirling. Filter the solution if it is cloudly. Store solution in a brown-glass reagent bottle.

6.2.3 Standard iodine solution, 0.01 N. Pipette 100.0 ml of the 0.1 N iodine solution into a 1-liter volumetric flask and dilute to volume with deionized, distilled water. Standardize daily as in Section 8.1.1. This solution must be protected from light. Reagent bottles and flasks must be kept tightly stoppered.

6.3 Analysis.

6.3.1 Sodium thiosulfate solution, standard 0.1 N. Dissolve 24.8 g of sodium thiosulfate pentahydrate ($Na_2S_2O_3{\cdot}5H_2O$) or 15.8 g of anhydrous sodium thiosulfate ($Na_2S_2O_3$) in 1 liter of deionized, distilled water and add 0.01 g of anhydrous sodium carbonate (Na_2CO_3) and 0.4 ml of chloroform ($CHCl_3$) to stabilize. Mix thoroughly by shaking or by aerating with nitrogen for approximately 15 minutes and store in a glass-stoppered, reagent bottle. Standardize as in Section 8.1.2.

6.3.2 Sodium thiosulfate solution, standard 0.01 N. Pipette 50.0 ml of the standard 0.1 N thiosulfate solution into a volumetric flask and dilute to 500 ml with distilled water.

Note - A 0.01 N phenylarsine oxide solution may be prepared instead of 0.01 N thiosulfate (see Section 6.3.3).

6.3.3 Phenylarsine oxide solution, standard 0.01 N. Dissolve 1.80 g of phenylarsine oxide (C_6H_5AsDO) in 150 ml of 0.3 N sodium hydroxide. After settling, decant 140 ml of this solution into 800 ml of distilled water. Bring the solution to pH 6-7 with 6N hydrochloric acid and dilute to 1 liter. Standardize as in Section 8.1.3.

6.3 Analysis.

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6.3.2 Sodium thiosulfate solution, standard 0.01 N. Pipette 50.0 ml of the standard 0.1 N thiosulfate solution into a volumetric flask and dilute to 500 ml with distilled water.

Note - A 0.01 N phenylarsine oxide solution may be prepared instead of 0.01 N thiosulfate (see Section 6.3.3).

6.3.3 Phenylarsine oxide solution, standard 0.01 N. Dissolve 1.80 g of phenylarsine oxide (C_6H_5AsDO) in 150 ml of 0.3 N sodium hydroxide. After settling, decant 140 ml of this solution into 800 ml of distilled water. Bring the solution to pH 6-7 with 6N hydrochloric acid and dilute to 1 liter. Standardize as in Section 8.1.3.

6.3.4 Starch indicator solution. Suspend 10 g of soluble starch in 100 ml of deionized, distilled water and add 15 g of potassium hydroxide (KOH) pellets. Stir until dissolved, dilute with 900 ml of deionized distilled water and let stand for 1 hour. Neutralize the alkali with concentrated hydrochloric acid, using an indicator paper similar to Alkacid test ribbon, then add 2 ml of glacial acetic acid as a preservative.

Note - Test starch indicator solution for decomposition by titrating, with 0.01 N iodine solution, 4 ml of starch solution in 200 ml of distilled water that contains 1 g potassium iodide. If more than 4 drops of the 0.01 N iodine solution are required to obtain the blue color, a fresh solution must be prepared.

7. Procedure.

7.1 Sampling.

7.1.1 Assemble the sampling train as shown in Figure 11-1, connecting the five midget impingers in series. Place 15 ml of 3 percent hydrogen peroxide solution in the first impinger. Leave the second impinger empty. Place 15 ml of the cadmium sulfate absorbing solution in the third, fourth, and fifth impingers. Place the impinger assembly in an ice bath container and place crushed ice around the impingers. Add more ice during the run, if needed.

7.1.2 Connect the rubber bulb and manometer to first impinger, as shown in Figure 11-1. Close the petcock on the dry gas meter outlet. Pressurize the train to 25-cm water pressure with the bulb and close off tubing connected to rubber bulb. The train must hold a 25-cm water pressure with not more than a 1-cm drop in pressure in a 1-minute interval. Stopcock grease is acceptable for sealing ground glass joints.

Note - This leak-check procedure is to be conducted at the beginning and the end of the sample run. Note also that if the pump is used for sampling, it is recommended (but not required) that the pump be leak-checked separately, using a method consistent with the leak-check procedure for diaphragm pumps outlined in Section 4.1.2 of Method 6.

7.1.3 Purge the connecting line between the sampling valve and first impinger, by disconnecting the line from the first impinger, opening the sampling valve, and allowing process gas to flow through the line for a minute or two. Then, close the sampling valve and reconnect the line to the impinger train. Open the petcock on the dry gas meter outlet. Record the initial dry gas meter reading.

7.1.2 Connect the rubber bulb and manometer to first impinger, as shown in Figure 11-1. Close the petcock on the dry gas meter outlet. Pressurize the train to 25-cm water pressure with the bulb and close off tubing connected to rubber bulb. The train must hold a 25-cm water pressure with not more than a 1-cm drop in pressure in a 1-minute interval. Stopcock grease is acceptable for sealing ground glass joints.

Note - This leak-check procedure is to be conducted at the beginning and the end of the sample run. Note also that if the pump is used for sampling, it is recommended (but not required) that the pump be leak-checked separately, using a method consistent with the leak-check procedure for diaphragm pumps outlined in Section 4.1.2 of Method 6.

7.1.3 Purge the connecting line between the sampling valve and first impinger, by disconnecting the line from the first impinger, opening the sampling valve, and allowing process gas to flow through the line for a minute or two. Then, close the sampling valve and reconnect the line to the impinger train. Open the petcock on the dry gas meter outlet. Record the initial dry gas meter reading.

7.1.4 Open the sampling valve and then adjust the valve to obtain a rate of approximately 1 liter/min. Maintain a constant (±10 percent) flow rate during the test. Record the meter temperature.

7.1.5 Sample for at least 10 min. At the end of the sampling time, close the sampling valve and record the final volume and temperature readings. Conduct a leak check as described in Section 7.1.2 above.

7.1.6 Disconnect the impinger train from the sampling line. Connect the charcoal tube and the pump, as shown in Figure 11-1. Purge the train (at a rate of 1 liter/min) with clean ambient air for 15 minutes to ensure that all H_2S is removed from the hydrogen peroxide. For sample recovery, cap the open ends and remove the impinger train to a clean area that is away from sources of heat. The area should be well lighted, but not exposed to direct sunlight.

7.2 Sample recovery.

7.2.1 Discard the contents of the hydrogen peroxide impinger. Carefully rinse the contents of the third, fourth, and fifth impingers into a 500 ml iodine flask.

Note - The impingers normally have only a thin film of cadmium sulfide remaining after a water rinse. If Antifoam B was not used or if significant quantities of yellow cadmium sulfide remain in the impingers, the alternate recovery procedure described below must be used.

7.2.2 Pipette exactly 50 ml of 0.01 N iodine solution into a 125 ml Erlenmeyer flask. Add 10 ml of 3 M HCl to the solution. Quantitatively rinse the acidified iodine into the iodine flask. Stopper the flask immediately and shake briefly.

7.2.3 (Alternate). Extract the remaining cadmium sulfide from the third, fourth, and fifth impingers using the acidified iodine solution. Immediately after pouring the acidified iodine into an impinger, stopper it and shake for a few moments, then transfer the liquid to the iodine flask. Do not transfer any rinse portion from one impinger to another; transfer it directly to the iodine flask. Once the acidified iodine solution has been poured into any glassware containing cadmium sulfide, the container must be tightly stoppered at all times except when adding more solution, and this must be done as quickly and carefully as possible. After adding any acidified iodine solution to the iodine flask, allow a few minutes for absorption of the H_2S before adding any further rinses. Repeat the

Note - The impingers normally have only a thin film of cadmium sulfide remaining after a water rinse. If Antifoam B was not used or if significant quantities of yellow cadmium sulfide remain in the impingers, the alternate recovery procedure described below must be used.

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iodine extraction until all cadmium sulfide is removed from the impingers. Extract that part of the connecting glassware that contains visible cadmium sulfide.

Quantitatively rinse all of the iodine from the impingers, connectors, and the beaker into the iodine flask using deionized, distilled water. Stopper the flask and shake briefly.

7.2.3 Allow the iodine flask to stand about 30 minutes in the dark for absorption of the H_2S into the iodine, then complete the titration analysis as in Section 7.3.

Note - Caution! Iodine evaporates from acidified iodine solutions. Samples to which acidified iodine have been added may not be stored, but must be analyzed in the time schedule stated in Section 7.2.3.

7.2.4 Prepare a blank by adding 45 ml of cadmium sulfate absorbing solution to an iodine flask. Pipette exactly 50 ml of 0.01 N iodine solution into a 125-ml Erlenmeyer flask. Add 10 ml of 3 M HCl. Follow the same impinger extracting and quantitative rinsing procedure carried out in sample analysis. Stopper the flask, shake briefly, let stand 30 minutes in the dark, and titrate with the samples.

Note: The blank must be handled by exactly the same procedure as that used for the samples.

7.3 Analysis.

Note - Titration analyses should be conducted at the sample-cleanup area in order to prevent loss of iodine from the sample. Titration should never be made in direct sunlight.

7.3.1 Using 0.01 N sodium thiosulfate solution (or 0.01 N phenylarsine oxide, if applicable), rapidly titrate each sample in an iodine flask using gentle mixing, until solution is light yellow. Add 4 ml of starch indicator solution and continue titrating slowly until the blue color just disappears. Record V_{TT}, the volume of sodium thiosulfate solution used, or V_{AT}, the volume of phenylarsine oxide solution used (ml).

7.3.2 Titrate the blanks in the same manner as the samples. Run blanks each day until replicate values agree within 0.05 ml. Average the replicate titration values which agree within 0.05 ml.

Note: The blank must be handled by exactly the same procedure as that used for the samples.

7.3 Analysis.

Note - Titration analyses should be conducted at the sample-cleanup area in order to prevent loss of iodine from the sample. Titration should never be made in direct sunlight.

7.3.1 Using 0.01 N sodium thiosulfate solution (or 0.01 N phenylarsine oxide, if applicable), rapidly titrate each sample in an iodine flask using gentle mixing, until solution is light yellow. Add 4 ml of starch indicator solution and continue titrating slowly until the blue color just disappears. Record V_{TT}, the volume of sodium thiosulfate solution used, or V_{AT}, the volume of phenylarsine oxide solution used (ml).

7.3.2 Titrate the blanks in the same manner as the samples. Run blanks each day until replicate values agree within 0.05 ml. Average the replicate titration values which agree within 0.05 ml.

8. Calibration and Standards

8.1 Standardizations.

8.1.1 Standardize the 0.01 N iodine solution daily as follows: Pipette 25 ml of the iodine solution into a 125 ml Erlenmeyer flask. Add 2 ml of 3 M HCl. Titrate rapidly with standard 0.01 N thiosulfate solution or with 0.01 N phenylarsine oxide until the solution is light yellow, using gentle mixing. Add four drops of starch indicator solution and continue titrating slowly until the blue color just disappears. Record V_T, the volume of thiosulfate solution used, or V_{AS}, the volume of phenylarsine oxide solution used (ml). Repeat until replicate values agree within 0.05 ml. Average the replicate titration values which agree within 0.05 ml and calculate the exact normality of the iodine solution using equation 9.3. Repeat the standardization daily.

8.1.2 Standardize the 0.1 N thiosulfate solution as follows: Oven-dry potassium dichromate ($K_2Cr_2O_7$) at 180 to 200°C (360 to 390°F). Weigh to the nearest milligram, 2 g of potassium dichromate. Transfer the dichromate to a 500 ml volumetric flask, dissolve in deionized, distilled water and dilute to exactly 500 ml. In a 500 ml iodine flask, dissolve approximately 3 g of potassium iodide (KI) in 45 ml of deionized, distilled water, then add 10 ml of

3 M hydrochloric acid solution. Pipette 50 ml of the dichromate solution into this mixture. Gently swirl the solution once and allow it to stand in the dark to 5 minutes. Dilute the solution with 100 to 200 ml of deionized, distilled water, washing down the sides of the flask with part of the water. Titrate with 0.1 N thiosulfate until the solution is light yellow. Add 4 ml of starch indicator and continue titrating slowly to a green end point. Record V_s. the volume of thiosulfate solution used (ml). Repeat until replicate analyses agree within 0.05 ml. Calculate the normality using equation 9.1. Repeat the standardization each week, or after each test series, whichever time is shorter.

8.1.3 Standardize the 0.01 N Phenylarsine oxide (if applicable) as follows: Oven dry potassium dichromate ($K_2Cr_2O_7$) at 180 to 200°C (360 to 390°F). Weigh to the nearest milligram, 2 g of the $K_2Cr_2O_7$; transfer the dichromate to a 500 ml volumetric flask, dissolve in deionized, distilled water, and dilute to exactly 500 ml. In a 500 ml iodine flask, dissolve approximately 0.3 g of potassium iodide (KI) in 45 ml of deionized, distilled water; add 10 ml of 3 M hydrochloric acid. Pipette 5 ml of the $K_2Cr_2O_7$ solution into the iodine flask. Gently swirl the contents of the flask once and allow to

3 M hydrochloric acid solution. Pipette 50 ml of the dichromate solution into this mixture. Gently swirl the solution once and allow it to stand in the dark to 5 minutes. Dilute the solution with 100 to 200 ml of deionized, distilled water, washing down the sides of the flask with part of the water. Titrate with 0.1 N thiosulfate until the solution is light yellow. Add 4 ml of starch indicator and continue titrating slowly to a green end point. Record V_s. the volume of thiosulfate solution used (ml). Repeat until replicate analyses agree within 0.05 ml. Calculate the normality using equation 9.1. Repeat the standardization each week, or after each test series, whichever time is shorter.

8.1.3 Standardize the 0.01 N Phenylarsine oxide (if applicable) as follows: Oven dry potassium dichromate ($K_2Cr_2O_7$) at 180 to 200°C (360 to 390°F). Weigh to the nearest milligram, 2 g of the $K_2Cr_2O_7$; transfer the dichromate to a 500 ml volumetric flask, dissolve in deionized, distilled water, and dilute to exactly 500 ml. In a 500 ml iodine flask, dissolve approximately 0.3 g of potassium iodide (KI) in 45 ml of deionized, distilled water; add 10 ml of 3 M hydrochloric acid. Pipette 5 ml of the $K_2Cr_2O_7$ solution into the iodine flask. Gently swirl the contents of the flask once and allow to

stand in the dark for 5 minutes. Dilute the solution with 100 to 200 ml of deionized, distilled water, washing down the sides of the flask with part of the water. Titrate with 0.01 N phenylarsine oxide until the solution is light yellow. Add 4 ml of starch indicator and continue titrating slowly to a green end point. Record V_A the volume of phenylarsine oxide used (ml). Repeat until replicate analyses agree within 0.05 ml. Calculate the normality using equation 9.2. Repeat the standardization each week or after each test series whichever time is shorter.

8.2 Sampling train calibration. Calibrate the sampling train components as follows:

8.2.1 Dry gas meter.

8.2.1.1 Initial calibration. The dry gas meter shall be calibrated before its initial use in the field. Proceed as follows: First, assemble the following components in series: Drying tube, needle valve, pump, rotameter, and dry gas meter. Then, leak-check the system as follows: Place a vacuum gauge (as least 760 mm Hg) at the inlet to the drying tube and pull a vacuum of 250 mm (10 in.) Hg; plug or pinch off the outlet of the flow meter, and then turn off the pump. The vacuum shall remain stable for at least 30 seconds. Carefully release the vacuum gauge before releasing the flow meter end.

Next, calibrate the dry gas meter (at the sampling flow rate specified by the method) as follows: Connect an appropriately sized wet test meter (e.g., 1 liter per revolution) to the inlet of the drying tube. Make three independent calibration runs, using at least five revolutions of the dry gas meter per run. Calculate the calibration factor. Y (wet test meter calibration volume divided by the dry gas meter volume, both volumes adjusted to the same reference temperature and pressure), for each run, and average the results. If any Y value deviates by more than 2 percent from the average, the dry gas meter is unacceptable for use. Otherwise, use the average as the calibration factor for subsequent test runs.

8.2.1.2 Post-test calibration check. After each field test series, conduct a calibration check as in Section 8.2.1.1 above, except for the following variations: (a) The leak check is not to be conducted, (b) three or more revolutions of the dry gas meter may be used, and (c) only two independent runs need be made. If the calibration factor does not deviate by more than 5 percent from the initial calibration factor (determined in Section 8.2.1.1), then the dry gas meter volumes obtained during the test series are

Next, calibrate the dry gas meter (at the sampling flow rate specified by the method) as follows: Connect an appropriately sized wet test meter (e.g., 1 liter per revolution) to the inlet of the drying tube. Make three independent calibration runs, using at least five revolutions of the dry gas meter per run. Calculate the calibration factor. Y (wet test meter calibration volume divided by the dry gas meter volume, both volumes adjusted to the same reference temperature and pressure), for each run, and average the results. If any Y value deviates by more than 2 percent from the average, the dry gas meter is unacceptable for use. Otherwise, use the average as the calibration factor for subsequent test runs.

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acceptable. If the calibration factor deviates by more than 5 percent, recalibrate the dry gas meter as in Section 8.2.1.1, and for the calculations, use the calibration factor (initial or recalibration) that yields the lower gas volume for each test run.

8.2.2 Thermometers. Calibrate against mercury-in-glass thermometers.

8.2.3 Rotameter. The rotameter need not be calibrated, but should be cleaned and maintained according to the manufacturer's instruction.

8.2.4 Barometer. Calibrate against a mercury barometer.

9. Calculations.

Carry out calculations retaining at least one extra decimal figure beyond that of the acquired data. Round off results only after the final calculation.

9.1 Normality of the Standard (0.1 N) Thiosulfate Solution.

$$N_S = 2.039W/V_S$$

where:

W = Weight of $K_2Cr_2O_7$ used, g.

V_S = Volume of $Na_2S_2O_3$ solution used, ml.

N_S = Normality of standard thiosulfate solution, g-eq/liter.

2.039 = Conversion factor

(6. eq. I_2/mole $K_2Cr_2O_7$) (1,000 ml/liter)/ = (294.2 g $K_2Cr_2O_7$/mole) (10 aliquot factor)

9.2 Normality of Standard Phenylarsine Oxide Solution (if applicable).

$$N_A = 0.2039\ W/V_A$$

where:

W = Weight of $K_2Cr_2O_7$ used, g.

V_A = Volume of $C_6H_5A_5O$ used, ml.

N_A = Normality of standard phenylarsine oxide solution, g=eg/liter.

0.2039 = Conversion factor

(6. eq. I_2/mole $K_2Cr_2O_7$) (1,000 ml/liter)/ = (249.2 g $K_2Cr_2O_7$/mole) (10 aliquot factor)

9.3 Normality of Standard Iodine Solution.

$$N_I = N_T V_T / V_I$$

where:

N_I = Normality of standard iodine solution, g-eg/liter.

V_I = Volume of standard iodine solution used, ml.

N_T = Normality of standard (0.01 N) thiosulfate solution; assumed to be 0.1 N_s. g-eq/liter.

V_T = Volume of thiosulfate solution used, ml.

N_S = Normality of standard thiosulfate solution, g-eq/liter.

2.039 = Conversion factor

(6. eq. I_2/mole $K_2Cr_2O_7$) (1,000 ml/liter)/ = (294.2 g $K_2Cr_2O_7$/mole) (10 aliquot factor)

9.2 Normality of Standard Phenylarsine Oxide Solution (if applicable).

$$N_A = 0.2039\ W/V_A$$

where:

W = Weight of $K_2Cr_2O_7$ used, g.

V_A = Volume of $C_6H_5A_5O$ used, ml.

N_A = Normality of standard phenylarsine oxide solution, g=eg/liter.

0.2039 = Conversion factor

(6. eq. I_2/mole $K_2Cr_2O_7$) (1,000 ml/liter)/ = (249.2 g $K_2Cr_2O_7$/mole) (10 aliquot factor)

9.3 Normality of Standard Iodine Solution.

$$N_I = N_T V_T / V_I$$

where:

N_I = Normality of standard iodine solution, g-eg/liter.

V_I = Volume of standard iodine solution used, ml.

N_T = Normality of standard (0.01 N) thiosulfate solution; assumed to be 0.1 N_s. g-eq/liter.

V_T = Volume of thiosulfate solution used, ml.

Note - If phenylarsine oxide is used instead of thiosulfate, replace N_T and V_T in equation 9.3 with N_A and V_{AS} respectively (see Sections 8.1.1 and 8.1.3).

9.4 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C) and 760 mm Hg.

$$V_{m(std)} = V_m Y \left[(T_{std}/T_m)(P_{bar}/P_{std})\right]$$

where:

$V_{m(std)}$ = Volume at standard conditions of gas sample through the dry gas meter, standard liters.

V_m = Volume of gas sample through the dry gas meter (meter conditions), liters.

T_{std} = Absolute temperature at standard conditions, 293°K.

T_m = Average dry gas meter temperature, °K.

P_{bar} = Barometric pressure at the sampling site, mm Hg.

P_{std} = Absolute pressure at standard conditions, 760 mm Hg.

Y = Dry gas meter calibration factor.

9.5 Concentration of H_2S. Calculate the concentration of H_2S in the gas stream at standard conditions using the following equation:

$$C_{H_2S} = K[(V_{IT}N_I - V_{TT}N_T)\ \text{sample} - (V_{IT}N_I - V_{TT}N_T)\ \text{blank}]/V_{m(std)}$$

where (metric units):

C_{H_2S} = Concentraton of H_2S at standard conditions, mg/dscm.

K = Conversion factor = 17.04×10^3.

(34.07 g/mole H_2S) (1,000 liters/m^3) (1,000 mg/g)/ = 1,000 ml/liter) (2H_2S eq/mole)

V_{IT} = Volume of standard iodine solution = 50.0 ml.

N_I = Normality of standard iodine solution, g-eq/liter.

V_{TT} = Volume of standard (~0.01 N) sodium thiosulfate solution, ml.

N_T = Normality of standard sodium thiosulfate solution, g-eq/liter.

$V_{m(std)}$ = Dry gas volume at standard conditions, liters.

Note - If phenylarsine oxide is used instead of thiosulfate, replace N_T and V_{TT} in Equation 9.5 with N_A and V_{AT}, respectively (see Sections 7.3.1 and 8.1.3).

10. Stability.

The absorbing solution is stable for at least 1 month. Sample recovery and analysis should begin within 1 hour of sampling to minimize oxidation of the acidified cadmium sulfide. Once iodine has been added to the sample, the remainder of the analysis procedure must be completed according to Sections 7.2.2 through 7.3.2.

V_{IT} = Volume of standard iodine solution = 50.0 ml.

N_I = Normality of standard iodine solution, g-eq/liter.

V_{TT} = Volume of standard (~0.01 N) sodium thiosulfate solution, ml.

N_T = Normality of standard sodium thiosulfate solution, g-eq/liter.

$V_{m(std)}$ = Dry gas volume at standard conditions, liters.

Note - If phenylarsine oxide is used instead of thiosulfate, replace N_T and V_{TT} in Equation 9.5 with N_A and V_{AT}, respectively (see Sections 7.3.1 and 8.1.3).

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METHOD 15 - DETERMINATION OF HYDROGEN SULFIDE, CARBONYL SULFIDE, AND CARBON DISULFIDE EMISSIONS FROM STATIONARY SOURCES

INTRODUCTION

The method described below uses the principle of gas chromatographic separation and flame photometric detection (FPD). Since there are many systems or sets of operating conditions that represent usable methods of determining sulfur emissions, all systems which employ this principle, but differ only in details of equipment and operation, may be used as alternative methods, provided that the criteria set below are met.

1. Principle and Applicability

1.1 Principle: A gas sample is extracted from the emission source and diluted with clean dry air. An aliquot of the diluted sample is then analyzed for hydrogen sulfide (H_2S), carbonyl sulfide (COS), and carbon disulfide (CS_2) by gas chromatographic (GC) separation and flame photometric detection (FPD).

1.2 Applicability: This method is applicable for determination of the above sulfur compounds from tail gas control units of sulfur recovery plants.

2. Range and Sensitivity

2.1 Range. Coupled with a gas chromatographic system utilizing a 1-milliliter sample size, the maximum limit of the FPD for each sulfur compound is approximately 10 ppm. It may be necessary to dilute gas samples from sulfur recovery plants hundred-fold (99:1) resulting in an upper limit of about 1000 ppm for each compound.

2.2 The minimum detectable concentration of the FPD is also dependent on sample size and would be about 0.5 ppm for a 1 ml sample.

3. Interferences

3.1 Moisture Condensation. Moisture condensation in the sample delivery system, the analytical column, or the FPD burner block can cause losses or interferences. This potential is eliminated by heating the sample line, and by conditioning the smaple with dry dilution air to lower its dew point below the operating temperature of the GC/FPD analytical system prior to analysis.

3.2 Carbon Monoxide and Carbon Dioxide. CO and CO_2 have substantial desensitizing effects on the flame photometric detector even after 9:1 dilution. (Acceptable systems must demonstrate that they have eliminated this interference by some procedure such as eluding CO and CO_2, before any of the sulfur compounds to be measured.) Compliance with this requirement can be demonstrated by submitting chromatograms of calibration gases with and without CO_2 in the

2. Range and Sensitivity

2.1 Range. Coupled with a gas chromatographic system utilizing a 1-milliliter sample size, the maximum limit of the FPD for each sulfur compound is approximately 10 ppm. It may be necessary to dilute gas samples from sulfur recovery plants hundred-fold (99:1) resulting in an upper limit of about 1000 ppm for each compound.

2.2 The minimum detectable concentration of the FPD is also dependent on sample size and would be about 0.5 ppm for a 1 ml sample.

3. Interferences

3.1 Moisture Condensation. Moisture condensation in the sample delivery system, the analytical column, or the FPD burner block can cause losses or interferences. This potential is eliminated by heating the sample line, and by conditioning the smaple with dry dilution air to lower its dew point below the operating temperature of the GC/FPD analytical system prior to analysis.

3.2 Carbon Monoxide and Carbon Dioxide. CO and CO_2 have substantial desensitizing effects on the flame photometric detector even after 9:1 dilution. (Acceptable systems must demonstrate that they have eliminated this interference by some procedure such as eluding CO and CO_2, before any of the sulfur compounds to be measured.) Compliance with this requirement can be demonstrated by submitting chromatograms of calibration gases with and without CO_2 in the

diluent gas. The CO_2 level should be approximately 10 percent for the case with CO_2 present. The two chromatographs should show agreement within the precision limits of Section 4.1.

3.3 Elemental Sulfur. The condensation of sulfur vapor in the sampling line can lead to eventual coating and even blockage of the sample line. This problem can be eliminated along with the moisture problem by heating the sample line.

4. Precision

4.1 Calibration Precision. A series of three consecutive injections of the same calibration gas, at any dilution, shall produce results which do not vary by more than $\pm$13 percent from the mean of the three injections.

4.2 Calibration Drift. The calibration drift determined from the mean of three injections made at the beginning and end of any 8-hour period shall not exceed $\pm$5 percent.

5. Apparatus

5.1.1 Probe. The probe must be made of inert material such as stainless steel or glass. It should be designed to incorporate a filter and to allows calibration gas to enter the probe at or near the sample entry point. Any portion of the probe not exposed to the stack gas must be heated to prevent moisture condensation.

5.1.2 The sample line must be made of Teflon,[1/] no greater than 1.3 cm (1/2 in.) inside diameter. All parts from the probe to the dilution system must be thermostatically heated to 120°C.

5.1.3 Sample Pump. The sample pump shall be a leakless Teflon coated diaphragm type or equivalent. If the pump is upstream of the dilution system, the pump head must be heated to 120°C.

5.2 Dilution System. The dilution system must be constructed such that all sample contacts are made of inert material (e.g., stainless steel or Teflon). It must be heated to 120°C and be capable of approximately a 9:1 dilution of the sample.

5.3 Gas Chromatograph. The gas chromatograph must have at least the following components:

5.3.1 Oven. Capable of maintaining the separation column at the proper operating temperature ±1°C.

5.3.2 Temperature Gauge. To monitor column oven, detector, and exhaust temperature ±1°C.

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5.3 Gas Chromatograph. The gas chromatograph must have at least the following components:

5.3.1 Oven. Capable of maintaining the separation column at the proper operating temperature ±1°C.

5.3.2 Temperature Gauge. To monitor column oven, detector, and exhaust temperature ±1°C.

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5.3.3 Flow System. Gas metering system to measure sample, fuel, combustion gas, and carrier gas flows.

5.3.4 Flame Photometric Detector.

5.3.4.1 Electrometer. Capable of full scale amplification of linear ranges of 10^{-9} to 10^{-4} amperes full scale.

5.3.4.2 Power Supply. Capable of delivering up to 750 volts.

5.3.4.3 Recorder. Compatible with the output voltage range of the electrometer.

5.4 Gas Chromatograph Columns. The column system must be demonstrated to be capable of resolving three major reduced sulfur compounds: H_2S, COS, and CS_2.

To demonstrate that adequate resolution has been achieved the tester must submit a chromatograph of a calibration gas containing all three reduced sulfur compounds in the concentration range of the applicable standard. Adequate resolution will be defined as base line separation of adjacent peaks when the amplifier attenuation is set so that the smaller peak is at least 50 percent of fullscale. Base line separation is defined as a return to zero ± 5 percent in

the interval between peaks. Systems not meeting this criteria may be considered alternate methods subject to the approval of the Control Agency's Authorized Representative.

5.5.1 Calibration System. The calibration system must contain the following components.

5.5.2 Flow System. To measure air flow over permeation tubes at ±2 percent. Each flowmeter shall be calibrated after a complete test series with a wet test meter. If the flow measuring device differs from the wet test meter by 5 percent, the completed test shall be discarded. Alternatively, the tester may elect to use the flow data that would yield the lowest flow measurement. Calibration with a wet test meter before a test is optional.

5.5.3 Constant Temperature Bath. Device capable of maintaining the permeation tubes at the calibration temperature within ±0.1°C.

5.5.4 Temperature Gauge. Thermometer of equivalent to monitor bath temperature within ±1°C.

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5.5.3 Constant Temperature Bath. Device capable of maintaining the permeation tubes at the calibration temperature within ±0.1°C.

5.5.4 Temperature Gauge. Thermometer of equivalent to monitor bath temperature within ±1°C.

6. Reagents

6.1 Fuel. Hydrogen (H_2) prepurified grade or better.

6.2 Combustion Gas. Oxygen (O_2) or air, research purity or better.

6.3 Carrier Gas. Prepurified grade or better.

6.4 Diluent. Air containing less than 0.5 ppm total sulfur compounds and less than 10 ppm each of moisture and total hydrocarbons.

6.5 Calibration Gases. Permeation tubes, one each of H_2S, COS, and CS_2, gravimetrically calibrated and certified at some convenient operating temperature. These tubes consist of hermetically sealed FEP Teflon tubing in which a liquified gaseous substance is enclosed. The enclosed gas permeates through the tubing wall at a constant rate. When the temperature is constant, calibration gases covering a wide range of known concentrations can be generated by varying and accurately measuring the flow rate of diluent gas passing over the tubes. These calibration gases are used to calibrate the GC/FPD system and the dilution system.

7. Pretest Procedures

The following procedures are helpful in preventing any problem which might occur later and invalidate the entire test.

7.1 After the complete measurement system has been set up at the site the following procedures are to be completed before sampling is initiated.

7.1.1 Leak Test. Appropriate leak test procedures should be employed to verify the integrity of all components, sample lines, and connections. The following leak test procedure is suggested: For components upstream of the sample pump, attach the probe end of the sample line to a manometer or vacuum gauge, start the pump and pull greater than 50 mm (2 in.) Hg vacuum, close off the pump outlet, and then stop the pump and ascertain that there is no leak for 1 minute. For components after the pump, apply a slight positive pressure and check for leaks by applying a liquid (detergent in water, for example) at each joint. Bubbling indicates the presence of a leak.

7.1.2 System Performance. Since the complete system is calibrated following each test, the precise calibration of each component is not critical. However, these components should be verified to be operating properly. This verification can be performed by observing the response of flowmeters or the of GC output to changes in flow rates or calibration gas concentrations and ascertaining the response to be within predicted limits. If any component

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or the completed system fails to respond in a normal and predictable manner, the source of the discrepancy should be identified and corrected before proceeding.

8. Calibration

Prior to any sampling run, calibrate the system using the following procedures. (If more than one run is performed during any 24-hour period, a calibration need not be performed prior to the second and any subsequent runs. The calibration must, however, be verified as prescribed in section 10, after the last run made within the 24-hour period.)

8.1 General Considerations. This section outlines steps to be followed for use of the GC/FPD and the dilution system. The procedure does not include detailed instructions because the operation of these systems is complex, and it requires an understanding of the individual system being used. Each system should include a written operating manual describing in detail the operating procedures associated with each component in the measurement system. In addition, the operator should be familiar with the operating principles of the components; particularly the GC/FPD. The citations in the bibliography at the end of this method are recommended for review for this purpose.

8.2 Calibration Procedure. Insert the permeation tubes into the tube chamber. Check the bath temperature to assure agreement with the calibration temperature of the tubes within $\pm 0.1^{o}C$. Allow 24 hours for the tubes to equilibrate. Alternatively equilibration may be verified by injecting samples of calibration gas at 1-hour intervals. The permeation tubes can be assumed to have reached equilibrium when consecutive hourly samples agree within the precision limits of section 4.1.

Vary the amount of air flowing over the tubes to produce the desired concentrations for calibrating the analytical and dilution systems. The air flow across the tubes must at all times exceed the flow requirement of the analytical systems. The concentration in parts per million generated by a tube containing a specific permeant can be calculated as follows:

$$C = K \times Pr/ML$$

Equation 15-1

where

C = Concentration of permeant produced in ppm.

Pr = Permeation rate of the tube in ug/min.

M = Molecular weight of the permeant: g/g-mole.

L = Flow rate, l/min, of air over permeant @ $20^{o}C$, 760 mm Hg.

K = Gas constant at $20^{o}C$ and 760 mm Hg = 24.04 l/g mole.

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K = Gas constant at $20^{\circ}C$ and 760 mm Hg = 24.04 l/g mole.

8.3 Calibration of Analysis System. Generate a series of three or more known concentrations spanning the linear range of the FPD (approximately 0.05 to 1.0 ppm) for each of the four major sulfur compounds. Bypassing the dilution system, inject these standards into the GC/FPD analyzers and monitor the responses. Three injects for each concentration must yield the precision described in section 4.1. Failure to attain this precision is an indication of a problem in the calibration or analytical system. Any such problem must be identified and corrected before proceeding.

8.4 Calibration Curves. Plot the GC/FPD response in current (amperes) versus their causative concentrations in ppm on log-log coordinate graph paper for each sulfur compound. Alternatively, a least squares equation may be generated from the calibration data.

8.5 Calibration of Dilution System. Generate a known concentration of hydrogen sulfide using the permeation tube system. Adjust the flow rate of diluent air for the first dilution stage so that the desired level of dilution is approximated. Inject the diluted calibration gas into the GC/FPD system and monitor its response. Three injections for each dilution must yield the precision described in section 4.1. Failure to attain this precision in this step is an indication of a problem in the dilution system. Any such problem must be identified and corrected before proceeding. Using the calibration data for H_2S (developed under 8.3) determine the

diluted calibration gas concentration in ppm. Then calculate the dilution factor as the ratio of the calibration gas concentration before dilution to the diluted calibration gas concentration determined under this paragraph. Repeat this procedure for each stage of dilution required. Alternatively, the GC/FPD system may be calibrated by generating a series of three more more concentrations of each sulfur compound and diluting these samples before injecting them into the GC/FPD system. This data will then serve as the calibration data for the unknown samples and a separate determination of the dilution factor will not be necessary. However, the precision requirements of section 4.1 are still applicable.

9. Sampling and Analysis Procedure

9.1 Sampling. Insert the sampling probe into the test port making certain that no dilution air enters the stack through the port. Begin sampling and dilute the sample approximately 9:1 using the dilution system. Note that the precise dilution factor is that which is determined in paragraph 8.5. Condition the entire system with sample for a minimum of 15 minutes prior to commencing analysis.

9.2 Analysis. Aliquots of diluted sample are injected into the GC/FPD analyzer for analysis.

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9.2 Analysis. Aliquots of diluted sample are injected into the GC/FPD analyzer for analysis.

9.2.1 Sample Run. A sample run is composed of 16 individual analyses (injects) performed over a period of not less than 3 hours or more than 6 hours.

9.2.2 Observation for Clogging of Probe. If reductions in sample concentrations are observed during a sample run that cannot be explained by process conditions, the sampling must be interrupted to determine if the sample probe is clogged with particulate matter. If the probe is found to be clogged, the test must be stopped and the results up to that point discarded. Testing may resume after cleaning the probe or replacing it with a clean one. After each run, the sample probe must be inspected and, if necessary, dismantled and cleaned.

10. Post-Test Procedures

10.1 Sample Line Loss. A known concentration of hydrogen sulfide at the level of the applicable standard, $\pm$20 percent, must be introduced into the sampling system at the opening of the probe in sufficient quantities to ensure that there is an excess of sample which must be vented to the atmosphere. The sample must be transported through the entire sampling system to the measurement system in the normal manner. The resulting measured concentration should be compared to the known value to determine the sampling system loss. A sampling system loss of more than 20 percent is unacceptable. Sampling

losses of 0-20 percent must be corrected by dividing the resulting sample concentration by the fraction of recovery. The known gas sample may be generated using permeation tubes. Alternatively, cylinders of hydrogen sulfide mixed in air may be used provided they are traceable to permeation tubes. The optional pretest procedures provide a good guideline for determining if there are leaks in the sampling system.

10.2 Recalibration. After each run, or after a series of runs made within a 24-hour period, perform a partial recalibration using the procedures in secton 8. Only H_2S (or other permeant) need be used to recalibrate the GC/FPD analysis system (8.3) and the dilution system (8.5).

10.3 Determination of Calibration Drift. Compare the calibration curves obtained prior to the runs, to the calibration curves obtained under paragraph 10.1. The calibration drift should not exceed the limits set forth in paragraph 4.2. If the drift exceeds this limit, the intervening run or runs should be considered not valid. The tester, however, may instead have the option of choosing the calibration data set which would give the highest sample values.

11. Calculations

11.1 Determine the concentrations of each reduced sulfur compound detected directly from the calibration curves. Alternatively, the

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11. Calculations

11.1 Determine the concentrations of each reduced sulfur compound detected directly from the calibration curves. Alternatively, the

concentrations may be calculated using the equation for the least squares line.

11.2 Calculation of SO_2 Equivalent. SO_2 equivalent will be determined for each analysis made by summing the concentrations of each reduced sulfur compound resolved during the given analysis.

$$SO_2 \text{ equivalent} = \Sigma(H_2S, COS, 2\ CS_2)d$$

Equation 15-2

where:

SO_2 equivalent = The sum of the concentration for each of the measured compounds (COS, H_2S, CS_2) expressed as sulfur dioxide in ppm.

H_2S = Hydrogen sulfide, ppm.

COS = Carbonyl sulfide, ppm.

CS_2 = Carbon disulfide, ppm.

d = Dilution factor, dimensionless.

11.3 Average SO_2 equivalent will be determined as follows:

$$\text{Average } SO_2 \text{ equivalent} = \frac{\sum_{i=1}^{N} SO_2 \text{ equiv.}_i}{N\ (1 - Bwo)}$$

Equation 15-3

where:

Average SO_2 equivalent = Average SO_2 equivalent in ppm, dry basis.

SO_2 equivalent i = SO_2 in ppm as determined by Equation 15-2.

N = Number of analyses performed.

Bwo = Fraction of volume of water vapor in the gas stream as determined by Method 4 - Determination of Moisture in Stack Gases (36 FR 24887).

12 Example System

12.1 Apparatus

12.1.1 Sample System

12.1.1.1 Probe. Stainless steel tubing, 6.35 mm (1/4 in.) outside diameter, packed with glass wool.

12.1.1.2 Sample Line. 3/16 inch inside diameter Teflon tubing heated to 120°C. This temperature is controlled by a thermostatic heater.

12.1.1.3 Sample Pump. Leakless Teflon coated diaphragm type or equivalent. The pump head is heated to 120°C by enclosing it in the sample dilution box (12.2.4 below).

12.1.2 Dilution System. A schematic diagram of the dynamic dilution system is given in Figure 15-2. The dilution system is constructed such that all sample contacts are

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12.1.1.3 Sample Pump. Leakless Teflon coated diaphragm type or equivalent. The pump head is heated to 120°C by enclosing it in the sample dilution box (12.2.4 below).

12.1.2 Dilution System. A schematic diagram of the dynamic dilution system is given in Figure 15-2. The dilution system is constructed such that all sample contacts are

made of inert materials. The dilution system which is heated to 120°C must be capable of a minimum of 9:1 dilution of sample. Equipment used in the dilution system is listed below:

12.1.2.1 Dilution Pump. Model A-150 Kohmyhr Teflon positive displacement type, nonadjustable 150 cc/min. ±2.0 percent, or equivalent, per dilution stage. A 9:1 dilution of sample is accomplished by combining 150 cc of sample with 1350 cc of clean dry air as shown in Figure 15-2.

12.1.2.2 Valves. Three-way Teflon solenoid or manual type.

12.1.2.3 Tubing. Teflon tubing and fittings are used throughout from the sample probe to the GC/FPD to present an inert surface for sample gas.

12.1.2.4 Box. Insulated box, heated and maintained at 120°C, of sufficient dimensions to house dilution apparatus.

12.1.2.5 Flowmeters. Rotameters or equivalent to measure flow from 0 to 1500 ml/min. ±1 percent per dilution stage.

12.1.3 Gas Chromatrograph.

12.1.3.1 Column - 1.83 m (6 ft.) length of Teflon tubing, 2.16 mm (0.085 in.) inside diameter, packed with deactivated silica gel, or equivalent.

12.1.3.2 Sample Valve. Teflon six port gas sampling valve, equipped with a 1 ml sample loop, actuated by compressed air (Figure 15-1).

12.1.3.3 Oven. For containing sample valve, stripper column and separation column. The oven should be capable of maintaining an elevated temperature ranging from ambient to 100°C, constant within ±1°C.

12.1.3.4 Temperature Monitor. Thermocouple pyrometer to measure column oven, detector, and exhaust temperature ±1°C.

12.1.3.5 Flow System. Gas metering system to measure sample flow, hydrogen flow, oxygen flow and nitrogen carrier gas flow.

12.1.3.6 Detector. Flame photometric detector.

12.1.3.7 Electrometer. Capable of full scale amplification of linear ranges of 10^{-9} to 10^{-4} amperes full scale.

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12.1.3.7 Electrometer. Capable of full scale amplification of linear ranges of 10^{-9} to 10^{-4} amperes full scale.

12.1.3.8 Power Supply. Capable of delivering up to 750 volts.

12.1.3.9 Recorder. Compatible with the output voltage range of the electrometer.

12.1.4 Calibration. Permeation tube system (Figure 15-3).

12.1.4.1 Tube Chamber. Glass chamber of sufficient dimensions to house permeation tubes.

12.1.4.2 Mass Flowmeters. Two mass flowmeters in the range of 0-3 l/min. and 0-10 l/min. to measure air flow over permeation tubes at ± 2 percent. These flowmeters shall be cross-calibrated at the beginning of each test. Using a convenient flow rate in the measuring range of both flowmeters, set and monitor the flow rate of gas over the permeation tubes. Injection of calibration gas generated at this flow rate as measured by one flowmeter followed by injection of calibration gas at the same flow rate as measured by the other flowmeter should agree within the specified precision limits. If they do not, then there is a problem with the mass flow measurement. Each mass flowmeter shall be calibrated prior to the first test with a wet test meter and thereafter at least once each year.

12.1.4.3 Constant Temperature Bath. Capable of maintaining permeation tubes at certification temperature of 30°C within ± 0.1°C.

12.2 Reagents.

12.2.1 Fuel. Hydrogen (H_2) prepurified grade or better.

12.2.2 Combustion Gas. Oxygen (O_2) research purity or better.

12.2.3 Carrier Gas. Nitrogen (N_2) prepurified grade or better.

12.2.4 Diluent. Air containing less than 0.5 ppm total sulfur compounds and less than 10 ppm each of moisture and total hydrocarbons, and filtered using MSA filters 46727 and 79030, or equivalent. Removal of sulfur compounds can be verified by injecting dilution air only, described in section 8.3.

12.2.5 Compressed Air. 60 psig for GC valve actuation.

12.2.6 Calibration Gases. Permeation tubes gravimetrically calibrated and certified at 30.0°C.

12.1.4.3 Constant Temperature Bath. Capable of maintaining permeation tubes at certification temperature of 30°C within ± 0.1°C.

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13. Bibliography

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2. Stevens, R.K., A.E. O'Keeffe, and G.C. Ortman. "Absolute Calibration of a Flame Photometric Detector to Volatile Sulfur Compounds at Sub-Part-Per Million Levels." Environmental Science and Technology 3:7 (July, 1969).

3. Mulick, J.D., R.K. Stevens, and R. Baumgardner. "An Analytical System Designed to Measure Multiple Malodorous Compounds Related to Kraft Mill Activities." Presented at the 12th Conference on Methods in Air Pollution and Industrial Hygiene Studies, University of Southern California, Los Angeles, CA. April 6-8, 1971.

4. Devonald, R.H., R.S. Serenius, and A.D. McIntyre. "Evaluation of the Flame Photometric Detector for Analysis of Sulfur Compounds." Pulp and Paper Magazine of Canada, 73,3 (March 1972).

5. Grimley, K.W., W.S. Smith, and R.M. Martin. "The Use of a Dynamic Dilution System in the Conditioning of Stack Gases for Automated Analysis by a Mobile Sampling Van." Presented at the 63rd Annual APCA Meeting in St. Louis, MO. June 14-19, 1970.

6. General Reference. Standard Methods of Chemical Analysis Volume III A and B Instrumental Methods. Sixth Edition. Van Nostrand Reinhold Co.

12.3 Operating Parameters. The operating parameters for the GC/FPD system are as follows: nitrogen carrier gas flow rate of 100 cc/min., exhaust temperature of 110°C, detector temperature 105°C, oven temperature of 40°C, hydrogen flow rate of 80 cc/minute, oxygen flow rate of 20 cc/minute, and sample flow rate of 80 cc/minute.

12.4 Analysis. The sample valve is actuated for 1 minute in which time an aliquot of dilute sample is injected onto the separation column. The valve is then deactivated for the remainder of analysis cycle in which time the sample loop is refilled and the separation column continues to be foreflushed. The elution time for each compound will be determined during calibration.

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METHOD 16 - SEMICONTINUOUS DETERMINATION OF SULFUR EMISSIONS FROM STATIONARY SOURCES

INTRODUCTION

The method described below uses the principle of gas chromatographic separation and flame photometric detection. Since there are many systems or sets of operating conditions that represent usable methods of determining sulfur emissions, all systems which employ this principle, but differ only in details of equipment and operation, may be used as alternative methods, provided that the criteria set below are met.

1. Principle and Applicability

1.1 Principle: A gas sample is extracted from the emission source and diluted with clean dry air. An aliquot of the diluted sample is then analyzed for hydrogen sulfide (H_2S), methyl mercaptan (MeSH), dimethyl sulfide (DMS) and dimethyl disulfide (DMDS) by gas chromatographic (GC) separation and flame photometric detection (FPD). These four compounds are known collectively as total reduced sulfur (TRS).

1.2 Applicability: This method is applicable for determination of TRS compounds from recovery furnaces, lime kilns, and smelt dissolving tanks at kraft pulp mills.

2. Range and Sensitivity

2.1 Range. Coupled with a gas chromatographic system utilizing a ten milliliter sample size, the maximum limit of the FPD for each sulfur compound is approximately 1 ppm. This limit is expanded by dilution of the sample gas before analysis. Kraft mill gas samples are normally diluted tenfold (9:1), resulting in an upper limit of about 10 ppm for each compound.

For sources with emission levels between 10 and 100 ppm, the measuring range can be best extended by reducing the sample size to 1 milliliter.

2.2 Using the sample size, the minimum detectable concentration is approximately 50 ppb.

3. Interferences.

3.1 Moisture Condensation. Moisture condensation in the sample delivery system, the analytical column, or the FPD burner block can cause losses or interferences. This potential is eliminated by heating the sample line, and by conditioning the sample with dry dilution air to lower its dew point below the operating temperature of the GC/FPD analytical system prior to analysis.

3.2 Carbon Monoxide and Carbon Dioxide. CO and CO_2 have substantial desensitizing effect on the flame photometric detector even after

2. Range and Sensitivity

2.1 Range. Coupled with a gas chromatographic system utilizing a ten milliliter sample size, the maximum limit of the FPD for each sulfur compound is approximately 1 ppm. This limit is expanded by dilution of the sample gas before analysis. Kraft mill gas samples are normally diluted tenfold (9:1), resulting in an upper limit of about 10 ppm for each compound.

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3.2 Carbon Monoxide and Carbon Dioxide. CO and CO_2 have substantial desensitizing effect on the flame photometric detector even after

9:1 dilution. Acceptable systems must demonstrate that they have eliminated this interference by some procedure such as eluting these compounds before any of the compounds to be measured. Compliance with this requirement can be demonstrated by submitting chromatograms of calibration gases with and without CO_2 in the diluent gas. The CO_2 level should be approximately 10 percent for the case with CO_2 present. The two chromatographs should show agreement within the precision limits of Section 4.1.

3.3 Particulate Matter. Particulate matter in gas samples can cause interference by eventual clogging of the analytical system. This interference must be eliminated by use of a probe filter.

3.4 Sulfur Dioxide. SO_2 is not a specific interferent but may be present in such large amount that it cannot be effectively separated from other compounds of interest. The procedure must be designed to eliminate this problem either by the choice of separation columns or by removal of SO_2 from the sample. In the example system, SO_2 is removed by a citrate buffer solution prior to GC injection. This scrubber will be used when SO_2 levels are high enough to prevent baseline separation from the reduced sulfur compounds.

Compliance with this section can be demonstrated by submitting chromatographs of calibration gases with SO_2 present in the same quantities expected from the emission source to be tested.

Acceptable systems shall show baseline separation with the amplifier attenuation set so that the reduced sulfur compound of concern is at least 50 percent of full scale. Baseline separation is defined as a return to zero ± percent in the interval between peaks.

4. Precision and Accuracy

4.1 GC/FPD and Dilution System Calibration Precision. A series of three consecutive injections of the same calibration gas at any dilution, shall produce results which do not vary by more than ± 5 percent from the mean of the three injections.

4.2 GC/FPD and Dilution System Calibration Drift. The calibration drift determined from the mean of three injections made at the beginning and end of any 8 hour period shall not exceed ± 5 percent.

4.3 System Calibration Accuracy. Losses through the sample transport system must be measured and a correction factor developed to adjust the calibration accuracy to 100 percent.

5. Apparatus (See Figure 16-1).

5.1 Sampling.

5.1.1 Probe. The probe must be made of inert material such as stainless steel or glass. It should be designed to incorporate a filter and to allow calibration gas to enter the probe at or near the sample entry point. Any portion of the probe not exposed to the stack gas must be heated to prevent moisture condensation.

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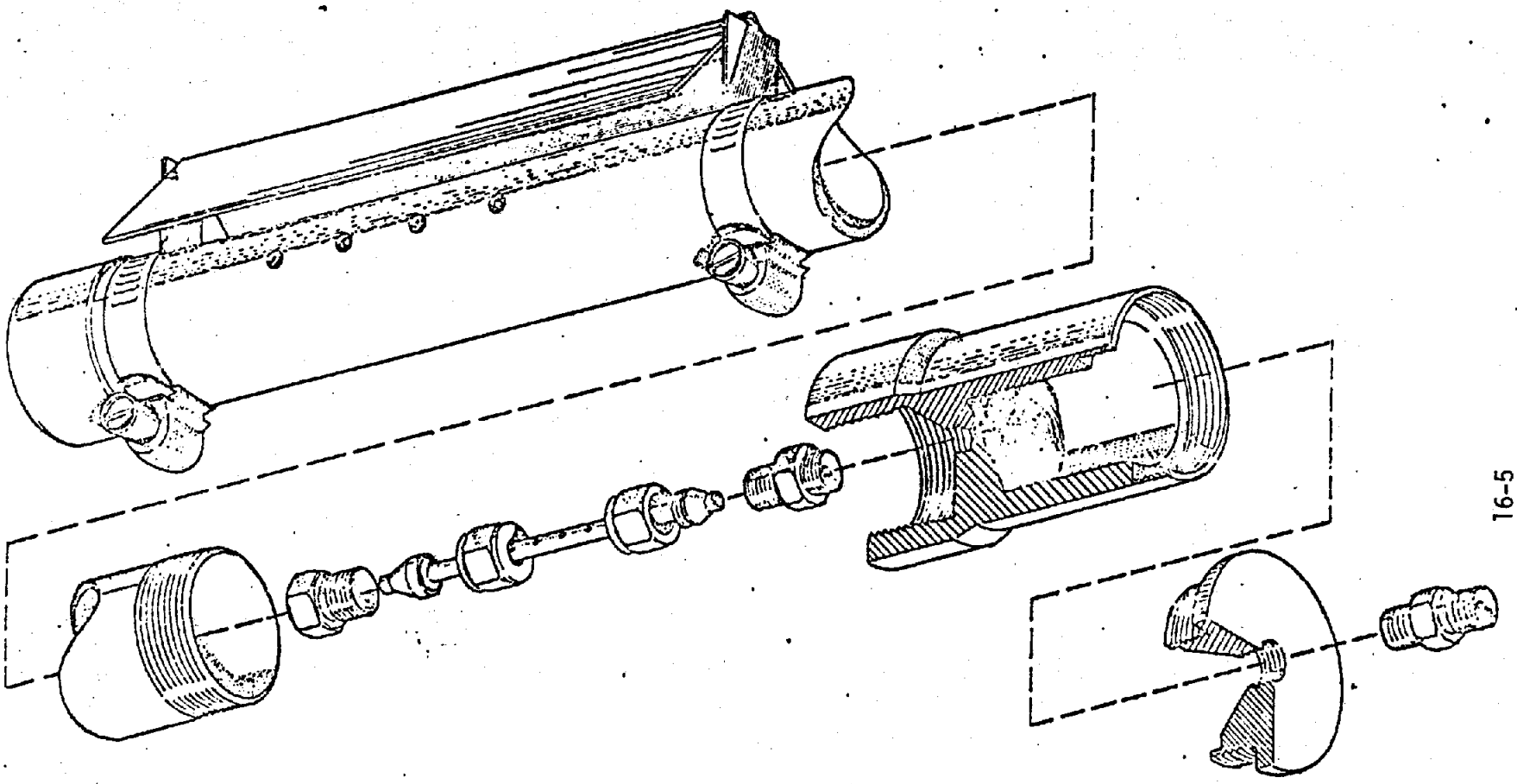

16-5

Figure 16-1. Probe used for sample gas containing high particulate loadings.

5.1.2 Sample Line. The sample line must be made of Teflon,[1/] no greater than 1.3 cm (1/2 in.) inside diameter. All parts from the probe to the dilution system must be thermostatically heated to 120°C.

5.1.3 Sample Pump. The sample pump shall be a leakless Teflon-coated diaphragm type or equivalent. If the pump is upstream of the dilution system, the pump heat must be heated to 120°C.

5.2 Dilution System. The dilution system must be constructed such that all sample contacts are made of inert materials (e.g., stainless steel or Teflon). It must be heated to 120°C and be capable of approximately a 9:1 dilution of the sample.

5.3 SO_2 Scrubber. The SO_2 scrubber is a midget impinger packed with glass wool to eliminate entrained mist and charged with potassium citrate-citric acid buffer.

5.4 Gas Chromatograph. The gas chromatograph must have at least he following components:

5.4.1 Oven. Capable of maintaining the separation column at the proper operating temperature ±1°C.

1/ Mention of trade names or specific products does not constitute endorsement by the Air Resources Board.

5.1.2 Sample Line. The sample line must be made of Teflon,[1/] no greater than 1.3 cm (1/2 in.) inside diameter. All parts from the probe to the dilution system must be thermostatically heated to 120°C.

5.1.3 Sample Pump. The sample pump shall be a leakless Teflon-coated diaphragm type or equivalent. If the pump is upstream of the dilution system, the pump heat must be heated to 120°C.

5.2 Dilution System. The dilution system must be constructed such that all sample contacts are made of inert materials (e.g., stainless steel or Teflon). It must be heated to 120°C and be capable of approximately a 9:1 dilution of the sample.

5.3 SO_2 Scrubber. The SO_2 scrubber is a midget impinger packed with glass wool to eliminate entrained mist and charged with potassium citrate-citric acid buffer.

5.4 Gas Chromatograph. The gas chromatograph must have at least he following components:

5.4.1 Oven. Capable of maintaining the separation column at the proper operating temperature ±1°C.

1/ Mention of trade names or specific products does not constitute endorsement by the Air Resources Board.

5.4.2 Temperature Gauge. To monitor column oven, detector, and exhaust temperature $\pm 1^{o}C$.

5.4.3 Flow System. Gas metering system to measure sample, fuel, combustion gas, and carrier gas flows.

5.4.4 Flame Photometric Detector.

5.4.4.1 Electrometer. Capable of full scale amplification of linear ranges of 10^{-9} to 10^{-4} amperes full scale.

5.4.4.2 Power Supply. Capable of delivering up to 750 volts.

5.4.4.3 Recorder. Compatible with the output voltage range of the electrometer.

5.5 Gas Chromatograph Columns. The column system must be demonstrated to be capable of resolving the four major reduced sulfur compounds: H_2S, MeSH, DMS, and DMDS. It must also demonstrate freedom from known interferences.

To demonstrate that adequate resolution has been achieved, the tester must submit a chromatograph of a calibration gas containing all four of the TRS compounds in the concentration range of the applicable standard. Adequate resolution will be defined as base line separation of adjacent peaks when the amplifier attenuation is

set so that the smaller peak is at least 50 percent of full scale. Base line separation is defined in Section 3.4. Systems not meeting this criteria may be considered alternate methods subject to the approval of the Control Agency's Authorized Representative.

5.6 Calibration System. The calibration system must contain the following components:

5.6.1 Tube Chamber. Chamber of glass or Teflon of sufficient dimensions to house permeation tubes.

5.6.2 Flow System. To measure air flow over permeation tubes at ±2 percent. Each flow meter shall be calibrated after a complete test series with a wet test meter. If the flow measuring device differs from the wet test meter by 5 percent, the completed test shall be discarded. Alternatively, the tester may elect to use the flow data that would yield the lower flow measurement. Calibration with a wet test meter before a test is optional.

5.6.3 Constant Temperature Bath. Device capable of maintaining the permeation tubes at the calibration temperature within ±0.1°C.

5.6.4 Temperature Gauge. Thermometer or equivalent to monitor bath temperature within ±1°C.

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5.6.4 Temperature Gauge. Thermometer or equivalent to monitor bath temperature within ±1°C.

6. Reagents

6.1 Fuel. Hydrogen (H_2) prepurified grade or better.

6.2 Combustion Gas. Oxygen (O_2) or air, research purity or better.

6.3 Carrier Gas. Prepurified grade or better.

6.4 Diluent. Air containing less than 50 ppb total sulfur compounds and less than 10 ppm each of moisture and total hydrocarbons. This gas must be heated prior to mixing with the sample to avoid water condensation at the point of contact.

6.5 Calibration Gases. Permeation tubes, one each of H_2S, MeSH, DMS, and DMDS, gravimetrically calibrated and certified at some convenient operating temperature. These tubes consist of hermetically sealed FEP Teflon tubing in which a liquified gaseous substance is enclosed. The enclosed gas permeates through the tubing wall at a constant rate. When the temperature is constant, calibration gases covering a wide range of known concentrations can be generated by varying and accurately measuring the flow rate of diluent gas passing over the tubes. These calibration gases are used to calibrate the GC/FPD system and the dilution system.

6.6 Citrate Buffer. Dissolve 300 grams of potassium citrate and 41 grams of anhydrous citric acid in 1 liter of deionized water. Two hundred eighty-four grams of sodium citrate may be substituted for the potassium citrate.

7. Pretest Procedures.

The following procedures are helpful in preventing any problem which might occur later and invalidate the entire test.

7.1 After the complete measurement system has been set up at the site and deemed to be operational, the following procedures are to be completed before sampling is initiated.

7.1.1 Leak Test. Appropriate leak test procedures should be employed to verify the integrity of all components, sample lines, and connections. The following leak test procedure is suggested: For components upstream of the sample pump, attach the probe end of the sample line to a manometer or vacuum gauge, start the pump and pull greater than 50 mm (2 in.) Hg vacuum, close off the pump outlet, and then stop the pump and ascertain that there is no leak for 1 minute. For components after the pump, apply a slight positive pressure and check for leaks by applying a liquid (detergent in water, for example) at each joint. Bubbling indicates the presence of a leak.

6.6 Citrate Buffer. Dissolve 300 grams of potassium citrate and 41 grams of anhydrous citric acid in 1 liter of deionized water. Two hundred eighty-four grams of sodium citrate may be substituted for the potassium citrate.

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7.1.2 System Performance. Since the complete system is calibrated following each test, the precise calibration of each component is not critical. However, these components should be verified to be operating properly. This verification can be performed by observing the response of flowmeters or of the GC output to changes in flow rates or calibration gas concentrations and ascertaining the response to be within predicted limits. In any component, or if the complete system fails to respond in a normal and predictable manner, the source of the discrepancy should be identified and corrected before proceeding.

8. Calibration

Prior to any sampling run, calibrate the system using the following procedures. (If more than one run is performed during any 24-hour period, a calibration need not be performed prior to the second and any subsequent runs. The calibration must, however, be verified as prescribed in Section 10, after the last run made within the 24-hour period.)

8.1 General Considerations. This section outlines steps to be followed for use of the GC/FPD and the dilution system. The procedure does not include detailed instructions because the operation of these systems is complex, and it requires an understanding of the individual system being used. Each system should include a written

operating manual describing in detail the operating procedures associated with each component in the measurement system. In addition, the operator should be familiar with the operating principles of the components; particularly the GC/FPD.

8.2 Calibration Procedure. Insert the permeation tubes into the tube chamber. Check the bath temperature to assure agreement with the calibraton temperature of the tubes within $\pm 0.1^{o}C$. Allow 24 hours for the tubes to equilibrate. Alternatively equilibration may be verified by injecting samples of calibration gas at 1-hour intervals. The permeation tubes can be assumed to have reached equilibrium when consecutive hourly samples agree within the precision limits of Section 4.1.

Vary the amount of air flowing over the tubes to produce the desired concentrations for calibrating the analytical and dilution systems. The air flow across the tubes must at all times exceed the flow requirement of the analytical systems. The concentration in parts per million generated by a tube containing a specific permeant can be calculated as follows:

$$C = K\left(\frac{P_r}{ML}\right)$$

Equation 16-1

where:

C = Concentration of permeant produces in ppm.

P_r = Permeation rate of the tube in ug/min.

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Equation 16-1

where:

C = Concentration of permeant produces in ppm.

P_r = Permeation rate of the tube in ug/min.

M = Molecular weight of the permeant (g/g-mole).

L = Flow rate, l/min, of air over permeant @ 20°C, 760 mm Hg.

K = Gas constant at 20°C and 760 mm Hg = 24.04 l/g mole.

8.3 Calibration of Analysis System. Generate a series of three or more known concentrations spanning the linear range of the FPD (approximately 0.05 to 1.0 ppm) for each of the four major sulfur compounds. Bypassing the dilution system, but using the SO_2 scrubber, inject these standards into the GC/FPD analyzers and monitor the responses. Three injects for each concentration must yield the precision described in Section 4.1. Failure to attain this precision is an indication of a problem in the calibration or analytical system. Any such problem must be identified and corrected before processing.

8.4 Calibration Curves. Plot the GC/FPD response in current (amperes) versus their causative concentrations in ppm on log-log coordinate graph paper for each sulfur compound. Alternatively, a least squares equation may be generated from the calibration data.

8.5 Calibration of Dilution System. Generate a known concentration of hydrogen sulfide using the permeation tube system. Adjust the flow rate of diluent air for the first dilution stage so that the desired level of dilution is approximated. Inject the diluted calibration gas into the GC/FPD system and monitor its response. Three

injections for each dilution must yield the precision described in Section 4.1. Failure to attain this precision in this step is an indication of a problem in the dilution system. Any such problem must be identified and corrected before proceeding. Using the calibration data for H_2S (developed under 8.3) determine the diluted calibration gas concentration in ppm. Then calculate the dilution factor as the ratio of the calibration gas concentration before dilution to the diluted calibration gas concentration determined under this paragraph. Repeat this procedure for each stage of dilution required. Alternatively, the GC/FPD system may be calibrated by generating a series of three or more concentrations of each sulfur compound and diluting these samples before injecting them into the GC/FPD system. This data will then serve as the calibration data for the unknown samples and a separate determination of the dilution factor will not be necessary. However, the precision requirements of Section 4.1 are still applicable.

9. Sampling and Analysis Procedure

9.1 Sampling. Insert the sampling probe into the test port making certain that no dilution air enters the stack through the port. Begin sampling and dilute the sample approximately 9:1 using the dilution system. Note that the precise dilution factor is that which is determined in paragraph 8.5. Condition the entire system with sample for a minimum of 15 minutes prior to commencing analysis.

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9.2 Analysis. Aliquots of diluted sample pass through the SO_2 scrubber, and then are injected into the GC/FPD analyzer for analysis.

9.2.1 Sample Run. A sample run is composed of 16 individual analyses (injects) performed over a period of not less than 3 hours or more than 6 hours.

9.2.2 Observation for Clogging of Probe. If reductions in sample concentrations are observed during a sample run that cannot be explained by process conditions, the sampling must be interrupted to determine if the sample probe is clogged with particulate matter. If the probe is found to be clogged, the test must be stopped and the results up to that point discarded. Testing may resume after cleaning the probe or replacing it with a clean one. After each run, the sample probe must be inspected and, if necessary, dismantled and cleaned.

10. Post-Test Procedures

10.1 Sample Line Loss. A known concentration of hydrogen sulfide at the level of the applicable standard, $\pm$20 percent, must be introduced into the sampling system at the opening of the probe in sufficient quantities to insure that there is an excess of sample which must be vented to the atmosphere. The sample must be transported through the entire sampling system to the measurement system in the normal manner. The resulting measured concentration should be compared to the known value to determine the sampling system loss.

For sampling losses greater than 20 percent in a sample run, the sample run is not to be used when determining the arithmetic mean of the performance test. For sampling losses of 0-20 percent, the sample concentration must be corrected by dividing the sample concentration by the fraction of recovery. The fraction of recovery is equal to one minus the ratio of the measured concentration to the known concentration of hydrogen sulfide in the sample line loss procedure. The known gas sample may be generated using permeation tubes. Alternatively, cylinders of hydrogen sulfide mixed in air may be used provided they are traceable to permeation tubes. The optional pretest procedures provide a good guideline for determining if there are leaks in the sampling system.

10.2 Recalibration. After each run, or after a series of runs made within a 24-hour period, perform a partial recalibration using the procedures in Section 8. Only H_2S (or other permeant) need be used to recalibrate the GC/FPD analysis system (8.3) and the dilution system (8.5).

10.3 Determination of Calibration Drift. Compare the calibration curves obtained prior to the runs, to the calibration curves obtained under paragraph 10.1. The calibration drift should not exceed the limits set forth in subsection 4.2. If the drift exceeds this limit, the intervening run or runs should be considered not valid. The tester, however, may instead have the option of choosing the calibration data set which would give the highest sample values.

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11. Calculations.

11.1 Determine the concentrations of each reduced sulfur compound detected directly from the calibration curves. Alternatively, the concentrations may be calculated using the equation for the least square line.

11.2 Calculation of TRS. Total reduced sulfur will be determined for each analysis made by summing the concentrations of each reduced sulfur compound resolved during a given analysis.

$$TRS = \Sigma(H_2S, MeSH, DMS, 2\ DMDS)d$$

Equation 16-2

where:

TRS = Total reduced sulfur in ppm, wet basis.

H_2S = Hydrogen sulfide, ppm.

MeSH = Methyl mercaptan, ppm.

DMS = Dimethyl sulfide, ppm.

DMDS = Dimethyl disulfide, ppm.

d = Dilution factor, dimensionless.

11.3 Average TRS. The average TRS will be determined as follows:

$$\text{Average TRS} = \frac{\sum_{i=1}^{N} TRS_i}{N(1-B_{wo})}$$

where:

Average TRS = Average total reduced sulfur in ppm, dry basis.

TRS_i = Total reduced sulfur in ppm as determined by Equation 16-2.

N = Number of samples

B_{wo} = Fraction of volume of water vapor in the gas stream as determined by Reference Method 1-4 - Determination of Moisture in Stack Gases.

11.4 Average concentration of individual reduced sulfur compounds.

$$C = \frac{\sum_{i=1}^{N} s_i}{N}$$

Equation 16-3

where:

s_i = Concentration of any reduced sulfur compound in the ith sample injection, ppm.

C = Average concentration of any one of the reduced sulfur compounds for the entire run, ppm.

N = Number of injections in any run period.

12. Example System

12.1 Apparatus

12.1.1 Sampling System

12.1.1.1 Probe. Figure 16-1 illustrates the probe used in lime kilns and other sources where significant amounts of particulate matter are present. The probe is designed with the deflector shield placed between the sample and the gas inlet holes and the glass wool plugs to reduce clogging of the filter and possible

N = Number of samples

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adsorption of sample gas. The exposed portion of the probe between the sampling port and the sample line is heated with heating tape.

12.1.1.2 Sample Line 3/16 inch inside diameter Teflon tubing, heated to 120°C. This temperature is controlled by a thermostatic heater.

12.1.1.3 Sample Pump. Leakless Teflon coated diaphragm type or equivalent. The pump head is heated to 120°C by enclosing it in the sample dilution box (12.1.2.4 below).

12.1.2 Dilution System. A schematic diagram of the dynamic dilution system is given in Figure 16-2. The dilution system is constructed such that all sample contacts are made of inert materials. The dilution system which is heated to 120°C must be capable of a minimum of 9:1 dilution of sample. Equipment used in the dilution system is listed below:

12.1.2.1 Dilution Pump. Model A-150 Kohmyhr Teflon positive displacement type, nonadjustable 150 cc/min. ±2.0 percent, or equivalent, per dilution stage. A 9:1 dilution of sample is

accomplished by combining 150 cc of sample with 1,350 cc of clean dry air as shown in Figure 16-2.

12.1.2.2 Valves. Three-way Teflon solenoid or manual type.

12.1.2.3 Tubing. Teflon tubing and fittings are used throughout from the sample probe to the GC/FPD to present an inert surface for sample gas.

12.1.2.4 Box. Insulated box, heated and maintained at 120°C, of sufficient dimensions to house dilution apparatus.

12.1.2.5 Flow meters. Rotameters or equivalent to measure flow from 0 to 1,500 ml/min ±1 percent per dilution stage.

12.1.3 SO_2 Scrubber. Midget impinger with 15 ml of potassium citrate buffer to absorb SO_2 in the sample.

12.1.4 Gas Chromatograph Columns. Two types of columns are used for separation of low and high molecular weight sulfur compounds:

accomplished by combining 150 cc of sample with 1,350 cc of clean dry air as shown in Figure 16-2.

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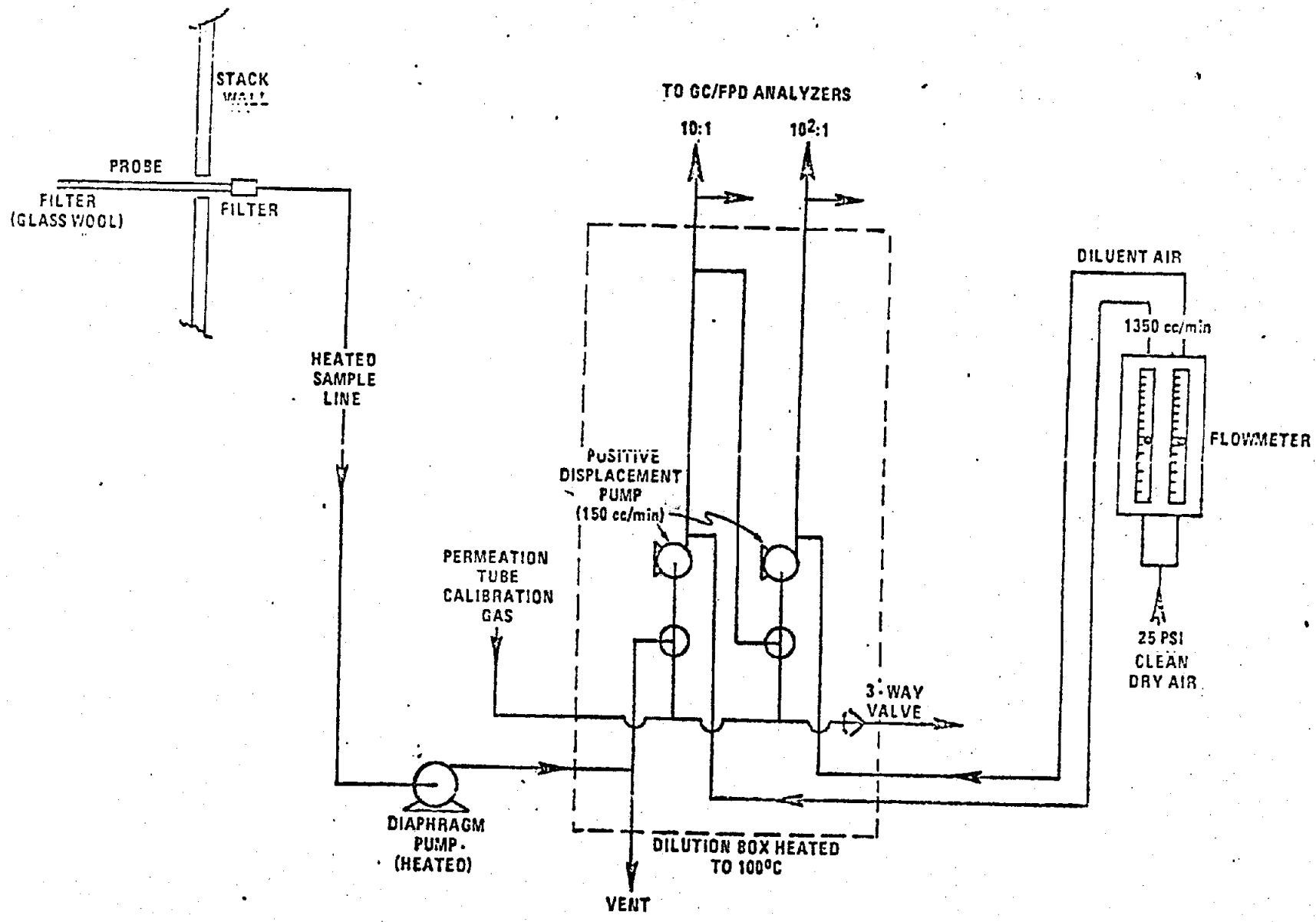

Figure 16-2. Sampling and dilution apparatus.

12.1.4.1 Low Molecular Weight Sulfur Compounds Column (GC/FPD-I).

12.1.4.1.1 Separation Column. 11 m by 2.16 mm (36 ft. by 0.085 in.) inside diameter Teflon tubing packed with 30/60 mesh Teflon coated with 5 percent polyphenyl ether and 0.05 percent orthophosphoric acid, or equivalent (see Figure 16-3).

12.1.4.1.2 Stripper or Precolumn. 0.6 m by 2.16 mm (2 ft. by 0.085 in.) inside diameter Teflon tubing.

12.1.4.1.3 Sample Valve. Teflon 10-port gas sampling valve, equipped with a 10 ml sample loop, actuated by compressed air (Figure 16-3).

12.1.4.1.4 Oven. For containing sample valve, stripper column and separation column. The oven should be capable of maintaining an elevated temperature ranging from ambient to 100°C, constant within ±1°C.

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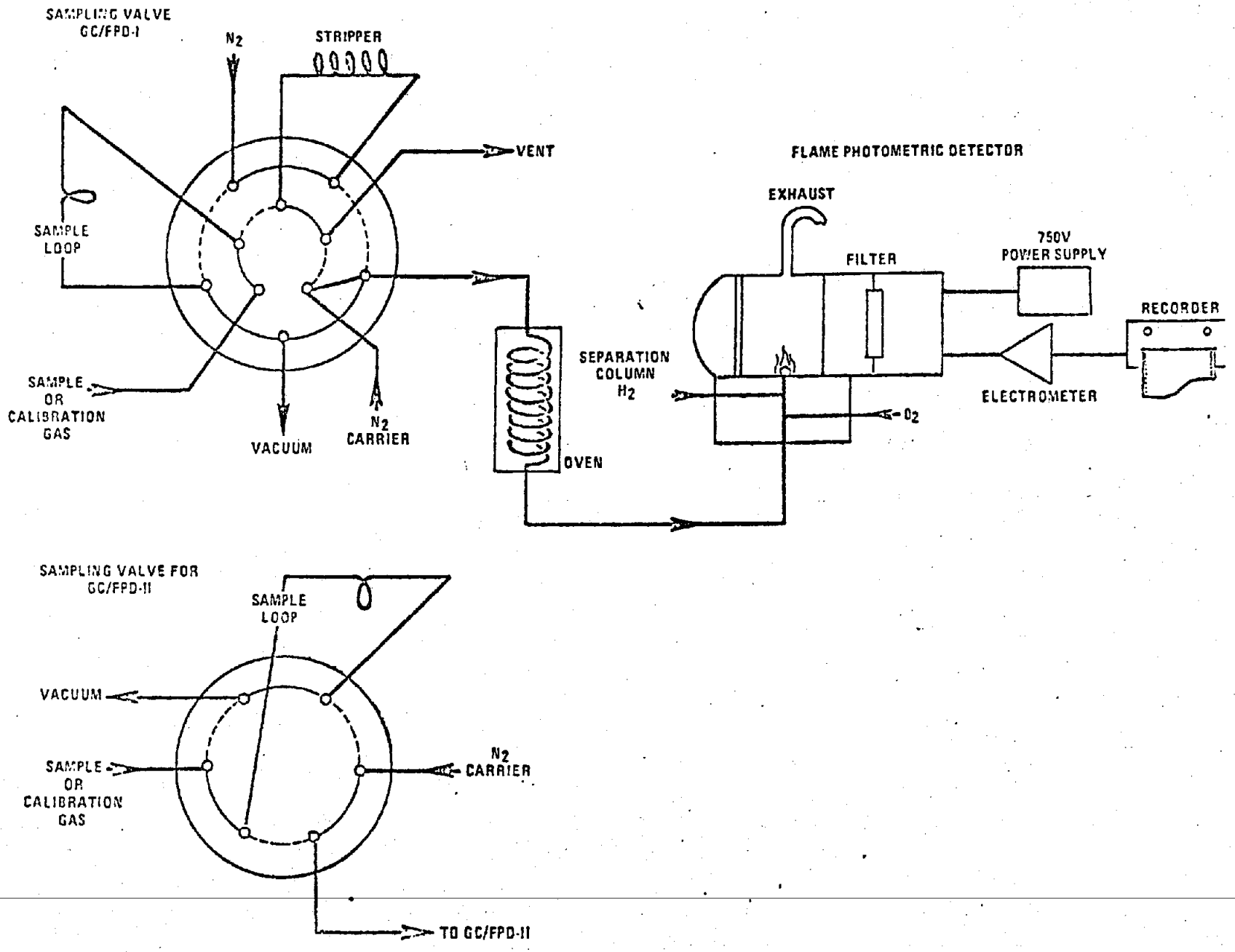

Figure 16-3. Gas chromatographic-flame photometric analyzers.

12.1.4.1.5 Temperature Monitor. Thermocouple pyrometer to measure column oven, detector, and exhaust temperature $\pm 1^{o}C$.

12.1.4.1.6 Flow System. Gas metering system to measure sample flow, hydrogen flow, and oxygen flow (and nitrogen carrier gas flow).

12.1.4.1.7 Detector. Flame photometric detector.

12.1.4.1.8 Electrometer. Capable of full scale amplification of linear ranges of 10^{-9} to 10^{-4} amperes full scale.

12.1.4.1.9 Power Supply. Capable of delivering up to 750 volts.

12.1.4.1.10 Recorder. Compatible with the output voltage range of the electrometer.

12.1.4.2 High Molecular Weight Compounds Column (GC/FPD-II).

12.1.4.1.5 Temperature Monitor. Thermocouple pyrometer to measure column oven, detector, and exhaust temperature $\pm 1^{o}C$.

12.1.4.1.6 Flow System. Gas metering system to measure sample flow, hydrogen flow, and oxygen flow (and nitrogen carrier gas flow).

12.1.4.1.7 Detector. Flame photometric detector.

12.1.4.1.8 Electrometer. Capable of full scale amplification of linear ranges of 10^{-9} to 10^{-4} amperes full scale.

12.1.4.1.9 Power Supply. Capable of delivering up to 750 volts.

12.1.4.1.10 Recorder. Compatible with the output voltage range of the electrometer.

12.1.4.2 High Molecular Weight Compounds Column (GC/FPD-II).

12.1.4.2.1 Separation Column. 3.05 m by 2.16 mm (10 ft by 0.085 in) inside diameter Teflon tubing packed with 30/60 mesh Teflon coated with 10 percent Triton X-305, or equivalent.

12.1.4.2.2 Sample Valve. Teflon 6-port gas sampling valve, equipped with a 10 ml sample loop, actuated by compressed air (Figure 16-3).

12.1.4.2.3 Other Components. All components same as in 12.1.4.1.4 to 12.1.4.1.10.

12.1.5 Calibration. Permeation tube system (Figure 16-4).

12.1.5.1 Tube Chamber. Glass chamber of sufficient dimensions to house permeation tubes.

12.1.5.2 Mass Flow meters. Two mass flow meters in the range 0-3 l/min. and 0-10 l/min. to measure air flow over permeation tubes at $\pm$2 percent. These flow meters shall be cross-calibrated at the beginning of each test. Using a convenient flow rate in the measuring range of both flow meters,

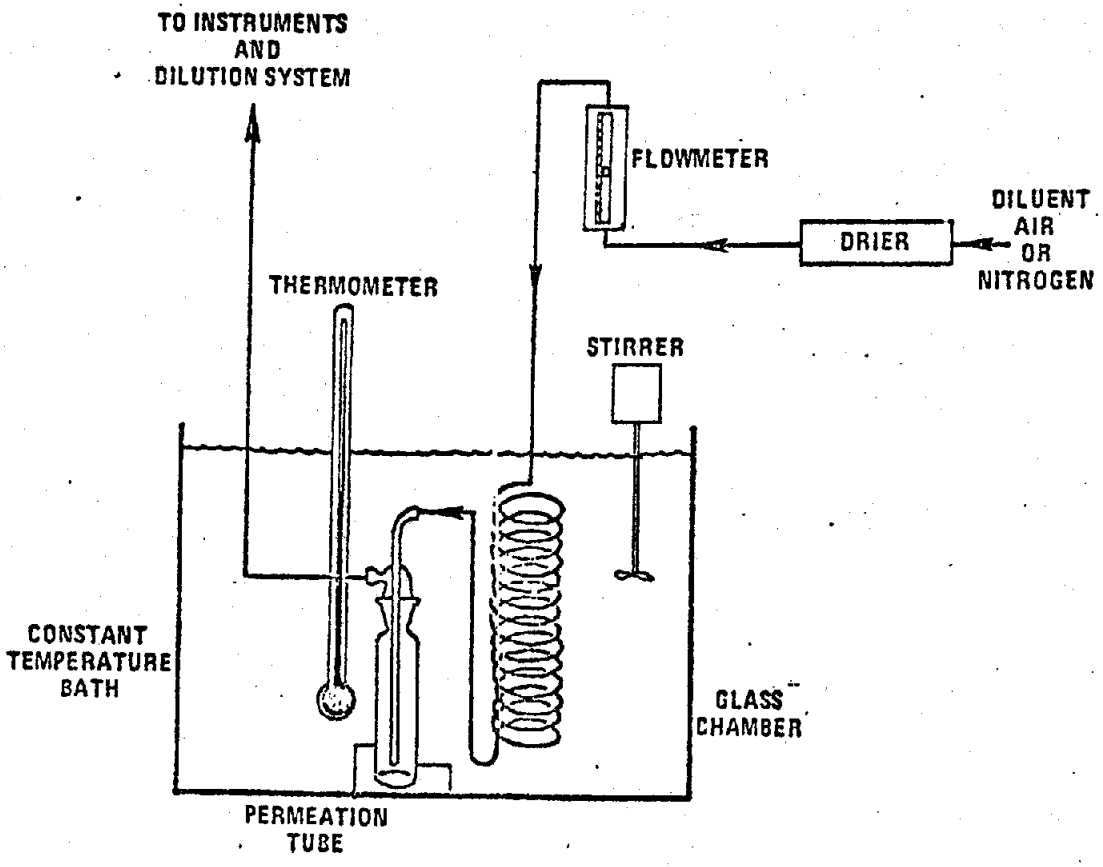

Figure 16-4. Apparatus for field calibration.

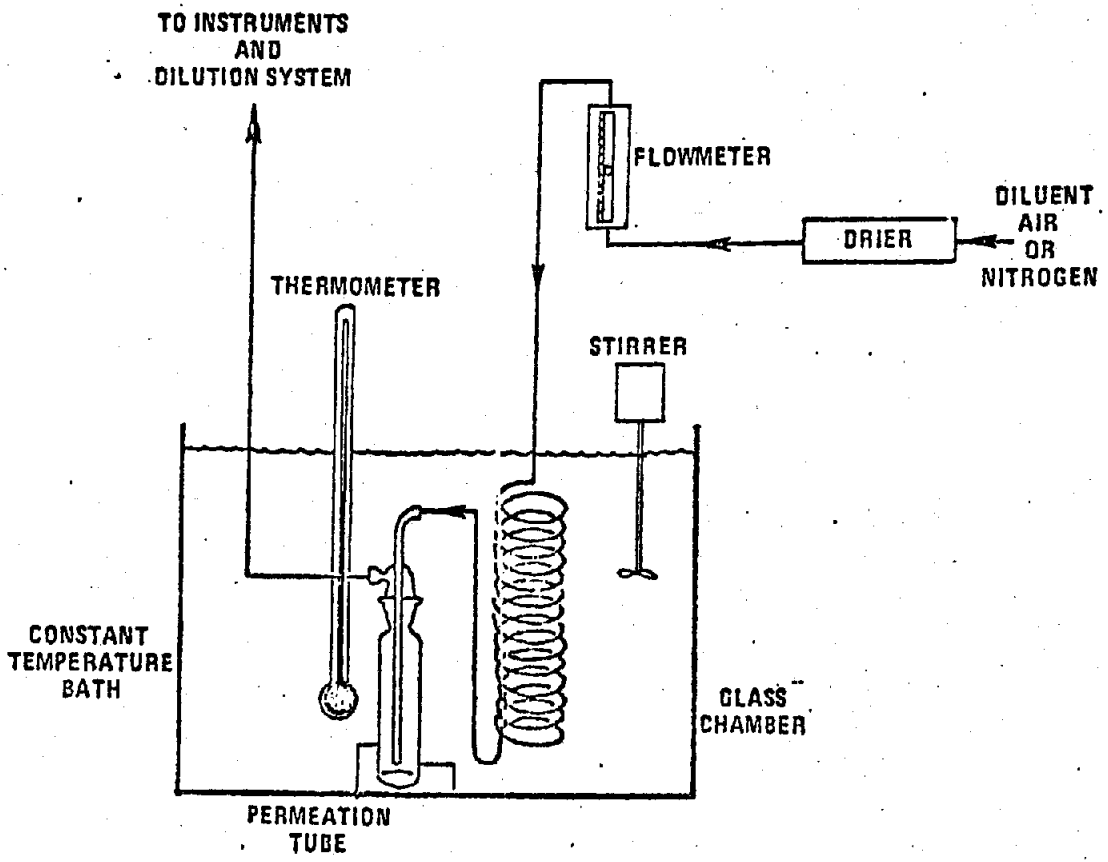

Figure 16-4. Apparatus for field calibration.

set and monitor the flow rate of gas over the permeation tubes. Injection of calibration gas generated at this flow rate as measured by one flow meter followed by injection of calibration gas at the same flow rate as measured by the other flow meter should agree within the specified precision limits. If they do not, then there is a problem with the mass flow measurement. Each mass flow meter shall be calibrated prior to the first test with a wet test meter and thereafter, at least once each year.

12.1.5.3 Constant Temperature Bath. Capable of maintaining permeation tubes at certification temperature of $30^{o}C$, within $\pm 0.1^{o}C$.

12.2 Reagents

12.2.1 Fuel. Hydrogen (H_2) prepurified grade or better.

12.2.2 Combustion Gas. Oxygen (O_2) research purity or better.

12.2.3 Carrier Gas. Nitrogen (N_2) prepurified grade or better.

12.2.4 Diluent. Air containing less than 50 ppb total sulfur compounds and less than 10 ppm each of moisture and total hydrocarbons, and filtered using MSA filters 46727 and 79030, or equivalent. Removal of sulfur compounds can be verified by injecting dilution air only, described in Section 8.3.

12.2.5 Compressed Air. 60 psig for GC valve actuation.

12.2.6 Calibrated Gases. Permeation tubes gravimetrically calibrated and certified at 30.0°C.

12.2.7 Citrate Buffer. Dissolve 300 grams of potassium citrate and 41 grams of anhydrous citric acid in 1 liter of deionized water. 284 grams of sodium citrate may be substituted for the potassium citrate.

12.3 Operating Parameters

12.3.1 Low-Molecular Weight Sulfur Compounds. The operating parameters for the GC/FPD system used for low molecular weight compounds are as follows: nitrogen carrier gas flow rate of 50 cc/min., exhaust temperature of 110°C, detector temperature of 105°C, oven temperature of 40°C, hydrogen flow rate of 80 cc/min., oxygen flow rate of 20 cc/min., and sample flow rate between 20 and 80 cc/min.

12.2.4 Diluent. Air containing less than 50 ppb total sulfur compounds and less than 10 ppm each of moisture and total hydrocarbons, and filtered using MSA filters 46727 and 79030, or equivalent. Removal of sulfur compounds can be verified by injecting dilution air only, described in Section 8.3.

12.2.5 Compressed Air. 60 psig for GC valve actuation.

12.2.6 Calibrated Gases. Permeation tubes gravimetrically calibrated and certified at 30.0°C.

12.2.7 Citrate Buffer. Dissolve 300 grams of potassium citrate and 41 grams of anhydrous citric acid in 1 liter of deionized water. 284 grams of sodium citrate may be substituted for the potassium citrate.

12.3 Operating Parameters

12.3.1 Low-Molecular Weight Sulfur Compounds. The operating parameters for the GC/FPD system used for low molecular weight compounds are as follows: nitrogen carrier gas flow rate of 50 cc/min., exhaust temperature of 110°C, detector temperature of 105°C, oven temperature of 40°C, hydrogen flow rate of 80 cc/min., oxygen flow rate of 20 cc/min., and sample flow rate between 20 and 80 cc/min.

12.3.2 High-Molecular Weight Sulfur Compounds. The operating parameters for the GC/FPD system for high molecular weight compounds are the same as in 12.3.1 except: oven temperature of 70°C, and nitrogen carrier gas flow of 100 cc/min.

12.4 Analysis Procedure.

12.4.1 Analysis. Aliquots of diluted sample are injected simultaneously into both GC/FPD analyzers for analysis. GC/FPD-I is used to measure the low-molecular weight reduced sulfur compounds. The low-molecular weight compounds include hydrogen sulfide, methyl mercaptan, and dimethyl sulfide. GC/FPD-II is used to resolve the high-molecular weight compound. The high-molecular weight compound is dimethyl disulfide.

12.4.1.1 Analysis of Low-Molecular Weight Sulfur Compounds. The sample valve is actuated for 3 minutes in which time an aliquot of diluted sample is injected into the stripper column and analytical column. The valve is then deactivated for approximately 12 minutes in which time, the analytical column continues to be foreflushed, the stripper column is backflushed, and the sample loop is refilled. Monitor the responses. The elution time for each compound will be determined during calibration.

13. Bibliography

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METHOD 17 - DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES (IN-STACK FILTRATION METHOD)

INTRODUCTION

Particulate matter is not an absolute quantity; rather, it is a function of temperature and pressure. Therefore, to prevent variability in particulate matter emission regulations and/or associated test methods, the temperature and pressure at which particulate matter is to be measured must be carefully defined. Of the two variables (i.e., temperature and pressure), temperature has the greater effect upon the amount of particulate matter in an effluent gas stream; in most stationary source categories, the effect of pressure appears to be negligible.

In Method 5, 250°F is established as a nominal reference temperature. Thus, where Method 5 is specified in an applicable subpart of the standards, particulate matter is defined with respect to temperature. In order to maintain a collection temperature of 250°F, Method 5 employs a heated glass sample probe and a heated filter holder. This equipment is somewhat cumbersome and requires care in its operation. Therefore, where particulate matter concentrations (over the normal range of temperature associated with a specified source category) are known to be independent of temperature, it is desirable to eliminate the glass probe and heating system, and sample at stack temperature.

This method describes an in-stack sampling system and sampling procedures for use in such cases. It is intended to be used only when specified by an

applicable subpart of the standards, and only within the applicable temperature limits (if specified), or when otherwise approved by the Control Agency's Authorized Representative.

1. Principle and Applicability

1.1 Principle: Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter maintained at stack temperature. The particulate mass is determined gravimetrically after removal of uncombined water.

1.2 Applicability: This method applies to the determination of particulate emissions from stationary sources for determining compliance with new source performance standards, only when specifically provided for in an applicable subpart of the standards. This method is not applicable to stacks that contain liquid droplets or are saturated with water vapor. In addition, this method shall not be used as written if the projected cross-sectional area of the probe extension-filter holder assembly covers more than 5 percent of the stack cross-sectional area (see Section 4.1.2).

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1. Principle and Applicability

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2. Apparatus

2.1 Sampling Train. A schematic of the sampling train used in this method is shown in Figure 17-1. Construction details for many, but not all, of the train components are given in APTD-0581 (Citation 2 in Section 7); for changes from the APTD-0581 document and for allowable modifications to Figure 17-1, consult with the Executive Officer. The operating and maintenance procedures for many of the sampling train components are described in APTD-0576 (Citation 3 in Section 7). Since correct usage is important in obtaining valid results, all users should read the APTD-0576 document and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. The sampling train consists of the following components:

2.1.1 Probe Nozzle. Stainless steel (316) or glass, with sharp, tapered leading edge. The angle of taper shall be 30° and the taper shall be on the outside to preserve a constant internal diameter. The probe nozzle shall be of the button-hook or elbow design, unless otherwise specified by the Control Agency's Authorized Representative. If made of stainless steel, the nozzle shall be constructed from seamless tubing. Other materials of construction may be used subject to the approval of the Control Agency's Authorized Representative.

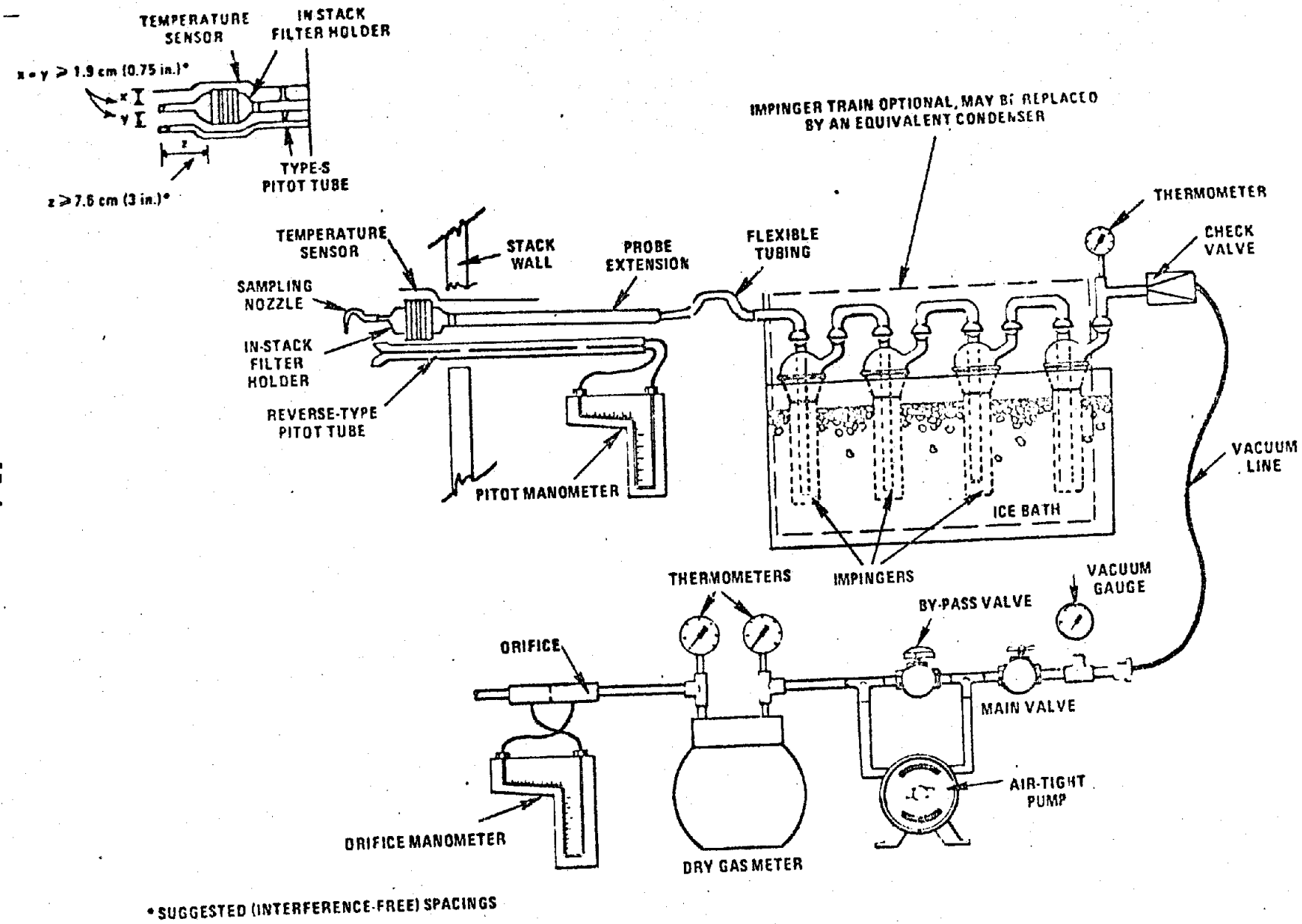

Figure 17-1. Particulate-Sampling Train, Equipped with In-Stack Filter.

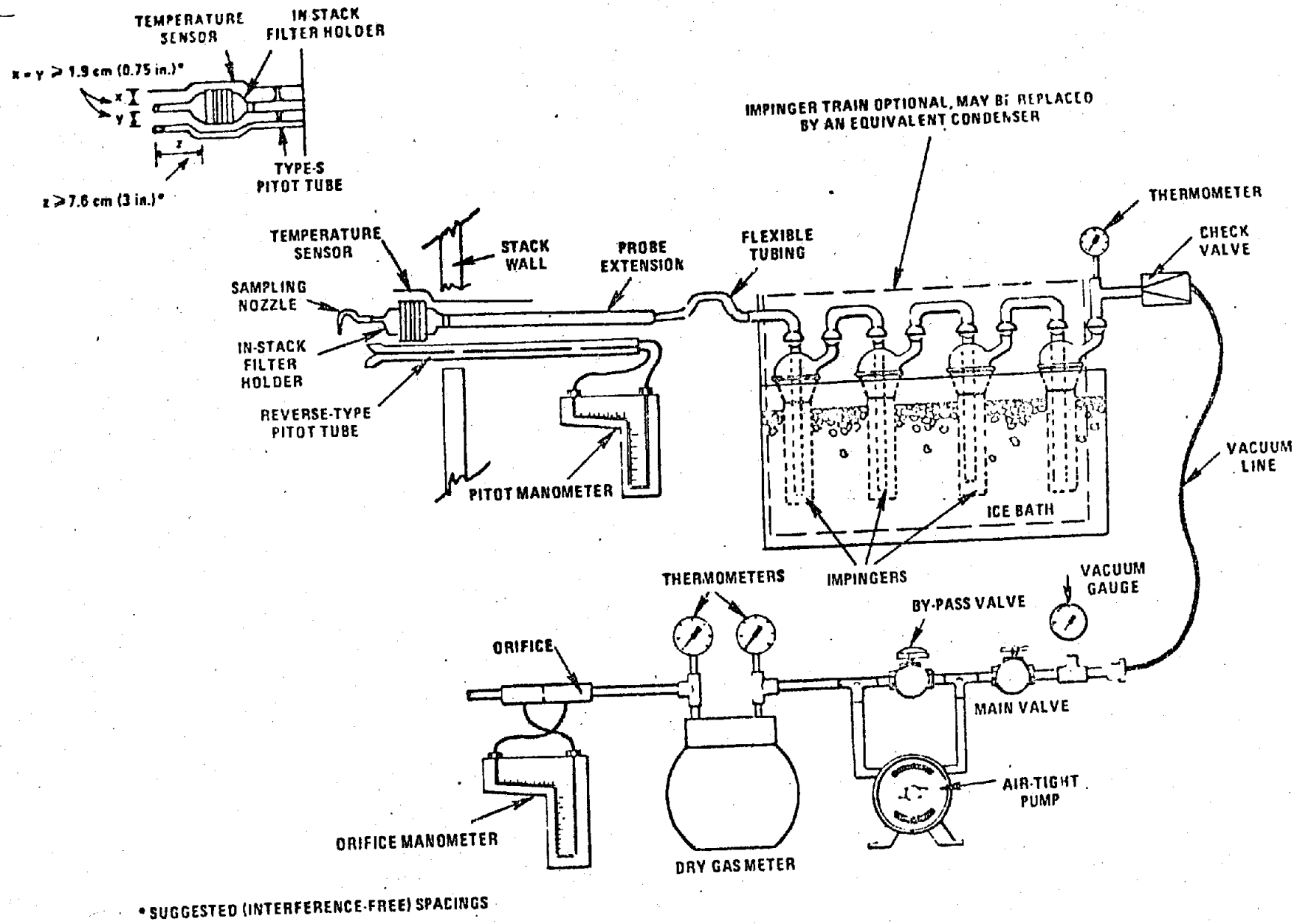

Figure 17-1. Particulate-Sampling Train, Equipped with In-Stack Filter.

A range of sizes suitable for isokinetic sampling should be available, e.g. 0.32 to 1.27 cm (1/8 to 1/2 in) - or larger if higher volume sampling trains are used - inside diameter (ID) nozzles in increments of 0.16 cm (1/16 in). Each nozzle shall be calibrated according to the procedures outlines in Section 5.1.

2.1.2 Filter Holder. The in-stack filter holder shall be constructed of borosilicate or quartz glass, or stainless steel; if a gasket is used, it shall be made of silicone rubber, Teflon, or stainless steel. Other holder and gasket materials may be used subject to the approval of the Control Agency's Authorized Representative. The filter holder shall be designed to provide a positive seal against leakage from the outside or around the filter.

2.1.3 Probe Extension. Any suitable rigid probe extension may be used after the filter holder.

2.1.4 Pitot Tube. Type S, as described in Section 2.1 of Method 2 or other device approved by the Control Agency's Authorized Representative , the pitot tube shall be attached to the probe extension to allow constant monitoring of the stack gas velocity (see Figure 17-1). The impact (high pressure) opening plane of the pitot tube

shall be even with or above the nozzle entry plane during sampling (see Method 2, Figure 2-6b). It is recommended: (1) that the pitot tube have a known baseline coefficient, determined as outlined in Section 4 of Method 2; and (2) that this known coefficient be preserved by placing the pitot tube in an interference-free arrangement with respect to the sampling nozzle, filter holder, and temperature sensor (see Figure 17-1). Note that the 1.9 cm (0.75 in) free-space between the nozzle and pitot tube shown in Figure 17-1, is based on a 1.3 cm (0.5 in) ID nozzle. If the sampling train is designed for sampling at higher flow rates than that described in APTD-0581, thus necessitating the use of larger sized nozzles, the free space shall be 1.9 cm (0.75 in.) with the largest sized nozzle in place.

Source-sampling assemblies that do not meet the minimum spacing requirements of Figure 17-1 (or the equivalent of these requirements, e.g., Figure 2-7 of Method 2) may be used; however, the pitot tube coefficients of such assemblies shall be determined by calibration, using methods subject to the approval of the Control Agency's Authorized Representative.

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2.1.5 Differential Pressure Gauge. Inclined manometer or equivalent device (two), as described in Section 2.2 of Method 2. One manometer shall be used for velocity head (ΔP) readings, and the other, for orifice differential pressure readings.

2.1.6 Condenser. It is recommended that the impinger system described in Method 5 be used to determine the moisture content of the stack gas. Alternatively, any system that allows measurement of both the water condensed and the moisture leaving the condenser, each to within 1 ml or 1 g, may be used. The moisture leaving the condenser can be measured either by: (1) monitoring the temperature and pressure at the exit of the condenser and using Dalton's law of partial pressures; or (2) passing the sample gas stream through a silica gel trap with exit gases kept below $20^{o}C$ ($68^{o}F$) and determining the weight gain.

Flexibile tubing may be used between the probe extension and condenser. If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel still be used between the condenser system and pump to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

2.1.7 Metering System. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter capable of measuring volume to within 2 percent, and related equipment, as shown in Figure 17-1. Other metering systems capable of maintaining sampling rates within 10 percent of isokinetic and of determining sample volumes to within 2 percent may be used, subject to the approval of the Control Agency's Authorized Representative. When the metering system is used in conjunction with a pitot tube, the system shall enable checks of isokinetic rates.

Sampling trains utilizing metering systems designed for higher flow rates than described in APTD-0581 or APTD-0576 may be used provided that the specifications of this method are met.

2.1.8 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and

2.1.7 Metering System. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter capable of measuring volume to within 2 percent, and related equipment, as shown in Figure 17-1. Other metering systems capable of maintaining sampling rates within 10 percent of isokinetic and of determining sample volumes to within 2 percent may be used, subject to the approval of the Control Agency's Authorized Representative. When the metering system is used in conjunction with a pitot tube, the system shall enable checks of isokinetic rates.

Sampling trains utilizing metering systems designed for higher flow rates than described in APTD-0581 or APTD-0576 may be used provided that the specifications of this method are met.

2.1.8 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and

sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.9 Gas Density Determination Equipment. Temperature sensor and pressure gauge, as described in Sections 2.3 and 2.4 of Method 2, and gas analyzer, if necessary, as described in Method 3.

The temperature sensor shall be attached to either the pitot tube or to the probe extension, in a fixed configuration. If the temperature sensor is attached in the field; the sensor shall be placed in an interference-free arrangement with respect to the Type S pitot tube openings (as shown in Figure 17-1 or in Figure 2-7 of Method 2). Alternatively, the temperature sensor need not be attached to either the probe extension of pitot tube during sampling, provided that a difference of not more than 1 percent in the average velocity measurement is introduced. This alternative is subject to the approval of the Control Agency's Authorized Representative.

2.2 Sample Recovery.

2.2.1 Probe Nozzle Brush. Nylon bristle brush with stainless steel wire handle. The brush shall be properly sized and shaped to brush out the probe nozzle.

2.2.2 Wash Bottles - Two. Glass wash bottles are recommended; polyethylene wash bottles may be used at the option of the tester. It is recommended that acetone not be stored in polyethylene botles for longer than a month.

2.2.3 Glass Sample Storage Containers. Chemically resistant, borosilicate glass bottles, for acetone washes, 500 ml or 1000 ml. Screw cap liners shall either be rubber-backed Teflon or shall be constructed so as to be leak-free and resistant to chemical attack by acetone. (Narrow mouth glass bottles have been found to be less prone to leakage.) Alternatively, polyethylene bottles may be used.

2.2.4 Petri Dishes. For filter samples; glass or polyethylene, unless otherwise specified by the Control Agency's Authorized Representative.

2.2.5 Graduated Cylinder and/or Balance. To measure condensed water to within 1 ml or 1 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. Any of these balances is suitable for use here and in Section 2.3.4.

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2.2.6 Plastic Storage Containers. Air tight containers to store silica gel.

2.2.7 Funnel and Rubber Policeman. To aid in transfer of silica gel to container; not necessary if silica gel is weighed in the field.

2.2.8 Funnel. Glass or polyethylene, to aid in sample recovery.

2.3 Analysis.

2.3.1 Glass Weighing Dishes.

2.3.2 Desiccator.

2.3.3 Analytical Balance. To measure to within 0.1 mg.

2.3.4 Balance. To measure to within 0.5 mg.

2.3.5 Beakers. 250 ml.

2.3.6 Hygrometer. To measure the relative humidity of the laboratory environment.

2.3.7 Temperature Gauge. To measure the temperature of the laboratory environment.

3. Reagents

3.1 Sampling.

3.1.1 Filters. The in-stack filters shall be glass mats or thimble fiber filters, without organic binders, and shall exhibit at least 99.5 percent efficiency (00.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D 2986-71. Test data from the supplier's quality control program are sufficient for this purpose.

3.1.2 Silica Gel. Indicating type, 6- to 16-mesh. If previously used, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Control Agency's Authorized Representative.

3.1.3 Crushed Ice.

3.1.4 Stopcock Grease. Acetone-insoluble, heat-stable silicone grease. Ths is not necessary if screw-on connectors with Teflon sleeves, or similar, are used. Alternatively, other types of stopcock grease may be used, subject to the approval of the Control Agency's Authorized Representative.

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3.2 Sample Recovery. Acetone, reagent grade, 0.001 percent residue, in glass bottles. Acetone from metal containers generally has a high residue blank and should not be used. Sometimes, suppliers transfer acetone to glass bottles from metal containers. Thus, acetone blanks shall be run prior to field use and only acetone with low blank values (0.001 percent) shall be used. In no case shall a blank value of greater than 0.001 percent of the weight of acetone used be subtracted from the sample weight.

3.3 Analysis.

3.3.1 Acetone. Same as 3.2.

3.3.2 Desiccant. Anhydrous calcium sulfate, indicating type. Alternatively, other types of desiccants may be used, subject to the approval of the Control Agency's Authorized Representative.

4. Procedure.

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

4.1.1 Pretest Preparation. All components shall be maintained and calibrated according to the procedure described in APTD-0576, unless otherwise specified herein.

Weigh several 200 to 300 g portions of silica gel in air-tight containers to the nearest 0.5 g. Record the total weight of the silica gel plus container, on each container. As an alternative, the silica gel need not be preweighed, but may be weighed directly in its impinger or sampling holder just prior to train assembly.

Check filters visually against light for irregularities and flaws or pinhole leaks. Label filters of the proper size on the back side near the edge using numbering machine ink. As an alternative, label the shipping containers (glass or plastic petri dishes) and keep the filters in these containers at all times except during sampling and weighing.

Desiccate the filters at $20 \pm 5.6^{\circ}C$ ($68 \pm 10^{\circ}F$) and ambient pressure for at least 24 hours and weigh at intervals of at least 6 hours to a constant weight, i.e., 0.5 mg change from previous weighing; record results to the nearest 0.1 mg. During each weighing the filter must not be exposed to the laboratory atmosphere for a period greater than 2 minutes and a relative humidity above 50 percent. Alternatively (unless otherwise specified by the Control Agency's Authorized Representative), the filters may be oven dried at $105^{\circ}C$ ($220^{\circ}F$) for 2 to 3 hours,

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desiccated for 2 hours, and weighed. Procedures other than those described, which account for relative humidity effects, may be used, subject to the approval of the Control Agency's Authorized Representative.

4.1.2 Preliminary Determinations. Select the sampling site and the minimum number of sampling points according to Method 1 or as specified by the Control Agency's Authorized Representative. Make a projected-area model of the probe extension-filter holder assembly, with the pitot tube face openings positioned along the centerline of the stack, as shown in Figure 17-2. Calculate the estimated cross-section blockage, as shown in Figure 17-2. If the blockage exceeds 5 percent of the duct cross sectional area, the tester has the following options: (1) a suitable out-of-stack filtration method may be used instead of in-stack filtration; or (2) a special in-stack arrangement, in which the sampling and velocity measurement sites are separate, may be used; for details concerning this approach, consult with the Control Agency's Authorized Representative. (See Citation 10 in Section 7.) Determine the stack pressure, temperature, and the range of velocity heads using Method 2; it is recommended that a leak-check of the pitot lines (see Method 2, Section 3.1) be performed. Determine the moisture content using Approximation Method 4 or its

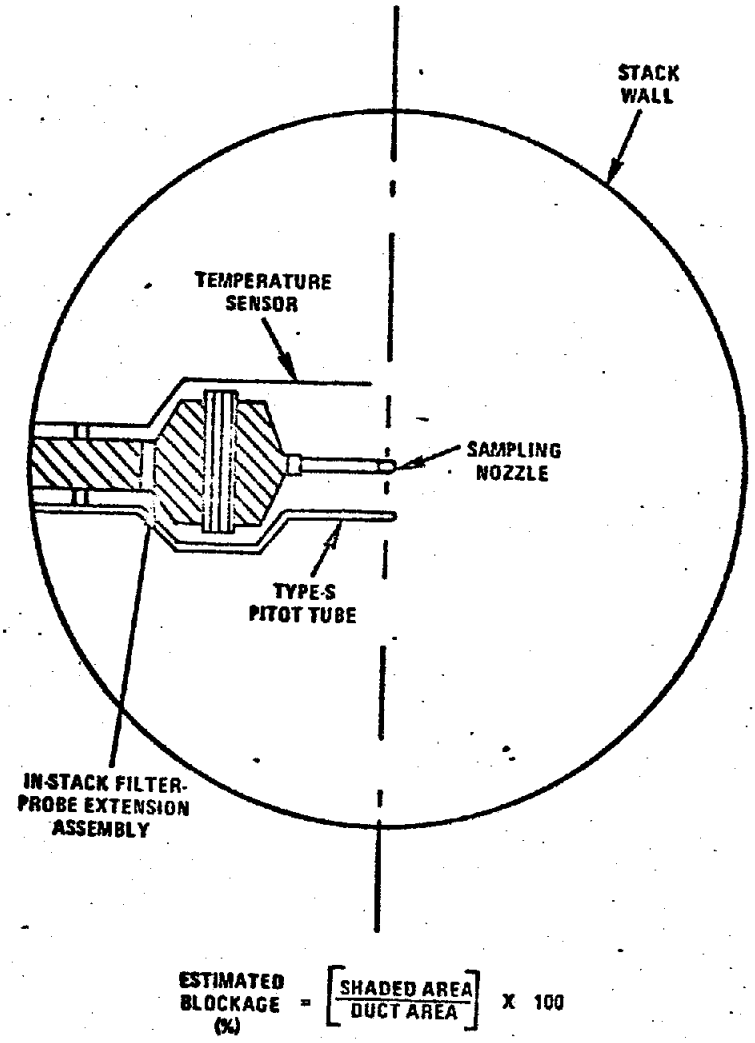

Figure 17-2. Projected-area model of cross-section blockage (approximate average for a sample traverse) caused by an in-stack filter holder-probe extension assembly.

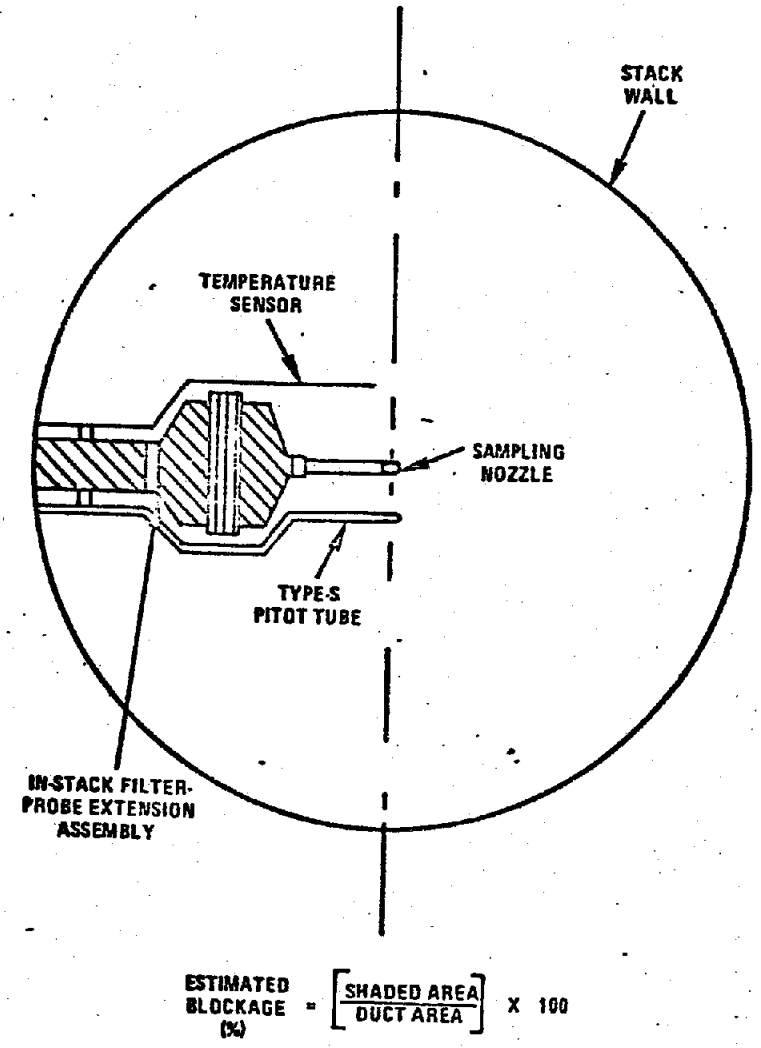

Figure 17-2. Projected-area model of cross-section blockage (approximate average for a sample traverse) caused by an in-stack filter holder-probe extension assembly.

alternatives for the purpose of making isokinetic sampling rate settings. Determine the stack gas dry molecular weight, as described in Method 2, Section 3.6; if integrated Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the particular sample run.

Select a nozzle size based on the range of velocity heads, such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Section 2.2 of Method 2).

Select a probe extension length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the length of probes.

Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that (1) the sampling time per point is not less than 2 minutes (or

some greater than interval if specified by the Control Agency's Authorized Representative), and (2) the sample volume taken (corrected to standard conditions) will exceed the required minimum total gas sample volume. The latter is based on an approximate average sampling rate.

It is recommended that the number of minutes sampled at each point be an integer or an integer plus one-half minute, in order to avoid timekeeping errors.

In some circumstances, e.g., batch cycles, it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas sample volumes. In these cases, the Control Agency's Authorized Representative 's approval must first be obtained.

4.1.3 Preparation of Collection Train. During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.

If impingers are used to condense stack gas moisture, prepare them as follows: place 100 ml of water in each of the first two impingers, leave the third impinger empty, and transfer approximtely 200 to 300 g of preweighed

some greater than interval if specified by the Control Agency's Authorized Representative), and (2) the sample volume taken (corrected to standard conditions) will exceed the required minimum total gas sample volume. The latter is based on an approximate average sampling rate.

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If impingers are used to condense stack gas moisture, prepare them as follows: place 100 ml of water in each of the first two impingers, leave the third impinger empty, and transfer approximtely 200 to 300 g of preweighed

silica gel from its container to the fourth impinger. More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

If some means other than impingers is used to condense moisture, prepare the condenser (and, if appropriate, silica gel for condenser outlet) for use.

Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as not to allow the sample gas stream to circumvent the filter. Check filter for tears after assembly is completed. Mark the probe extension with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

Assemble the train as in Figure 17-1, using a very light coat of silicone grease on all ground glass joints and greasing only the outer portion to avoid possibility of

contamination by the silicone grease. Place crushed ice around the impingers.

4.1.4 Leak Check Procedures

4.1.4.1 Pretest Leak-Check. A pretest leak-check is required. The following procedure shall be used.

After the sampling train has been assembled, plug the inlet to the probe nozzle with a material that will be able to withstand the stack temperature. Insert the filter holder into the stack and wait approximately 5 minutes (or longer, if necessary) to allow the system to come to equilibrium with the temperature of the stack gas stream. Turn on the pump and draw a vacuum of at least 380 mm Hg (15 in. Hg); note that a lower vacuum may be used, provided that it is not exceeded during the test. Determine the leakage rate. A leakage rate in excess of 4 percent of the average sampling rate or 0.00057 m^3 per min. (0.02 cfm), whichever is less, is unacceptable.

The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with by-pass valve

contamination by the silicone grease. Place crushed ice around the impingers.

4.1.4 Leak Check Procedures

4.1.4.1 Pretest Leak-Check. A pretest leak-check is required. The following procedure shall be used.

After the sampling train has been assembled, plug the inlet to the probe nozzle with a material that will be able to withstand the stack temperature. Insert the filter holder into the stack and wait approximately 5 minutes (or longer, if necessary) to allow the system to come to equilibrium with the temperature of the stack gas stream. Turn on the pump and draw a vacuum of at least 380 mm Hg (15 in. Hg); note that a lower vacuum may be used, provided that it is not exceeded during the test. Determine the leakage rate. A leakage rate in excess of 4 percent of the average sampling rate or 0.00057 m^3 per min. (0.02 cfm), whichever is less, is unacceptable.

The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with by-pass valve

fully open and coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the by-pass valve until the desired vacuum is reached. Do not reverse direction of by-pass valve. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check as shown below and start over.

When the leak-check is completed, first slowly remove the plug from the inlet to the probe nozzle and immediately turn off the vacuum pump. This prevents water from being forced backward and keeps silica gel from being entrained backward.

4.1.4.2 Leak-Checks During Sample Run. If, during the sampling run, a component (e.g., filter assembly or impinger) change becomes necessary, a leak-check shall be conducted immediately before the change is made. The leak-check shall be done according to the procedure outlined in Section 4.1.4.1 above, except that it shall be done at a vacuum equal to or greater than the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction

will need to be applied to the total volume of dry gas metered; if, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and plan to correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run.

Immediately after component changes, leak-checks are to be done per the procedure outlined in Section 4.1.4.1 above.

4.1.4.3 Post-Test Leak-Check. A leak-check is mandatory at the conclusion of each sampling run. The leak-check shall be done in accordance with the procedures outlined in Section 4.1.4.1 except that it shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered. If, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run.

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4.1.5 Particulate Train Operation. During the sampling run, maintain a sampling rate such that sampling is within 10 percent of true isokinetic, unless otherwise specified by the Control Agency's Authorized Representative.

For each run, record the data required on the example data sheet shown in Figure 17-3. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak check, and when sampling is halted. Take other readings required by Figure 17-3 at least once at each sample point during each time increment and additional readings when significant changes (20 percent variation in velocity head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

Clean the portholes prior to the test run to minimize the chance of sampling the deposited material. To begin sampling, remove the nozzle cap and verify that the pitot tube and probe extension are properly positioned. Position the nozzle at the first traverse point with the

PLANT _____

LOCATION _____

OPERATOR _____

DATE _____

RUN NO. _____

SAMPLE BOX NO. _____

METER BOX NO. _____

METER ΔH@ _____

C FACTOR _____

PITOT TUBE COEFFICIENT, Cp _____

SCHEMATIC OF STACK CROSS SECTION

BAROMETRIC PRESSURE _____

ASSUMED MOISTURE, % _____

PROBE EXTENSION LENGTH, m(ft.) _____

NOZZLE IDENTIFICATION NO. _____

AVERAGE CALIBRATED NOZZLE DIAMETER cm(in.) _____

FILTER NO. _____

LEAK RATE, m^3/min,(cfm) _____

STATIC PRESSURE, mm Hg (in. Hg) _____

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	VACUUM mm Hg (in. Hg)	STACK TEMPERATURE (T_S), °C (°F)	VELOCITY HEAD (ΔP_S), mm H_2O (in. H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER, mm H_2O (in. H_2O)	GAS SAMPLE VOLUME, m^3 (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °C (°F)
							INLET, °C (°F)	OUTLET, °C (°F)	
TOTAL							Avg	Avg	
AVERAGE							Avg		

Figure 17-3. Particulate field data.

PLANT _____

LOCATION _____

OPERATOR _____

DATE _____

RUN NO. _____

SAMPLE BOX NO. _____

METER BOX NO. _____

METER ΔH@ _____

C FACTOR _____

PITOT TUBE COEFFICIENT, Cp _____

SCHEMATIC OF STACK CROSS SECTION

BAROMETRIC PRESSURE _____

ASSUMED MOISTURE, % _____

PROBE EXTENSION LENGTH, m(ft.) _____

NOZZLE IDENTIFICATION NO. _____

AVERAGE CALIBRATED NOZZLE DIAMETER cm(in.) _____

FILTER NO. _____

LEAK RATE, m^3/min,(cfm) _____

STATIC PRESSURE, mm Hg (in. Hg) _____

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	VACUUM mm Hg (in. Hg)	STACK TEMPERATURE (T_S), °C (°F)	VELOCITY HEAD (ΔP_S), mm H_2O (in. H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER, mm H_2O (in. H_2O)	GAS SAMPLE VOLUME, m^3 (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °C (°F)
							INLET, °C (°F)	OUTLET, °C (°F)	
TOTAL							Avg	Avg	
AVERAGE							Avg		

Figure 17-3. Particulate field data.

tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs are available, which aid in the rapid adjustment to the isokinetic sampling rate without excessive computations. These nomographs are designed for use when the Type S pitot tube coefficient is 0.85 $\pm$0.02, and the stack gas equivalent density (dry molecular weight) is equal to 29$\pm$4. APTD-0576 details the procedure for using the nomographs. If C_p and M_d are outside the above stated ranges, do not use the nomographs unless appropriate steps (see Citation 7 in Section 7) are taken to compensate for the deviations.

When the stack is under significant negative pressure (height of impinger stem), take care to close the coarse adjust valve before inserting the probe extension assembly into the stack to prevent water from being forced backward. If necessary, the pump may be turned on with the coarse adjust valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

Traverse the stack cross section, as required by Method 1 or as specified by the Control Agency's Authorized Representative , being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe extension through the portholes, to minimize chance of extracting deposited material.

During the test run, take appropriate steps (e.g., adding crushed ice to the impinger ice bath) to maintain a temperature of less than 20°C (68°F) at the condenser outlet; this will prevent excessive moisture losses. Also, periodically check the level and zero of the manometer.

If the pressure drop across the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of a sample run. It is recommended that another complete filter holder assembly be used rather than attempting to change the filter itself. Before a new filter holder is installed, conduct a leak check, as outlined in Section 4.1.4.2. The total particulate weight shall include the summation of all filter assembly catches.

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A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or, in cases where equipment failure necessitates a change of trains. In all other situations, the use of two or more trains will be subject to the approval of the Control Agency's Authorized Representative. Not that when two or more trains are used, a separate analysis of the collected particulate from each train shall be performed, unless identical nozzle sizes were used on all trains, in which case the particulate catches from the individual trains may be combined and a single analysis performed.

At the end of the sample run, turn off the pump, remove the probe extension assembly from the stack, and record the final dry gas meter reading. Perform a leak-check, as outlined in Section 4.1.4.3. Also, leak-check the pitot lines as described in Section 3.1 of Method 2; the lines must pass this leak-check, in order to validate the velocity head data.

4.1.6 Calculation of Percent Isokinetic. Calculate percent isokinetic (see Section 6.11) to determine whether another test run should be made. If there is difficulty in

maintaining isokinetic rates due to source conditions, consult with the Control Agency's Authorized Representative for possible variance on the isokinetic rates.

4.2 Sample Recovery. Proper cleanup procedure begins as soon as the probe extension assembly is removed from the stack at the end of the sampling period. Allow the assembly to cool.

When the assembly can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while the sampling train is cooling down as this would create a vacuum in the filter holder, forcing condenser water backward.

Before moving the sample train to the cleanup site, disconnect the filter holder-probe nozzle assembly from the probe extension; cap the open inlet of the probe extension. Be careful not to lose any condensate, if present. Remove the umbilical cord from the condenser outlet and cap the outlet. If a flexible line is used between the first impinger (or condenser) and the probe extension, disconnect the line at the probe extension and let any condensed water or liquid drain into the impingers or condenser. Disconnect the probe extension from the condenser; cap the probe extension

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outlet. After wiping off the silicone grease, cap off the condenser inlet. Ground glass stoppers, plastic caps, or serum caps (whichever are appropriate) may be used to close these openings.

Transfer both the filter holder-probe nozzle assembly and the condenser to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.

Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used and place it in a glass sample container labeled "acetone blank."

Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

Container No. 1. Carefully remove the filter from the filter holder and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Carefully transfer to the petri dish any particulate matter and/or filter fibers which adhere to the filter holder gasket, by using a dry Nylon bristle brush and/or a sharp-edged blade. Seal the container.

Container No. 2. Taking care to see that dust on the outside of the probe nozzle or other exterior surfaces does not get into the sample, quantitatively recover particulate matter or any condensate from the probe nozzle, fitting, and front half of the filter holder by washing these compounds with acetone and placing the wash in a glass container. Distilled water may be used instead of acetone when approved by the Control Agency's Authorized Representative and shall be used when specified by the Control Agency's Authorized Representative , in these cases, save a water blank and follow Control Agency's Authorized Representative's directions on analysis. Perform the acetone rinses as follows:

Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a Nylon bristle brush. Brush until acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

Brush and rinse with acetone the inside parts of the fitting in a similar way until no visible particles remain. A funnel (glass or polyethylene) may be used to aid in transferring liquid washes to the container. Rinse the brush with acetone and quantitatively collect these washings in the sample container. Between sampling runs, keep brushes clean and protected from contamination.

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Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a Nylon bristle brush. Brush until acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

Brush and rinse with acetone the inside parts of the fitting in a similar way until no visible particles remain. A funnel (glass or polyethylene) may be used to aid in transferring liquid washes to the container. Rinse the brush with acetone and quantitatively collect these washings in the sample container. Between sampling runs, keep brushes clean and protected from contamination.

After ensuring that all joints are wiped clean of silicone grease (if applicable), clean the inside of the front half of the filter holder by rubbing the surfaces with a Nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make final rinse of the brush and filter holder. After all acetone washings and particulate matter are collected in the sample container, tighten the lid on the sample container so that acetone will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Label the container to clearly identify its contents.

Container No. 3. If silica gel is used in the condenser system for moisture content determination, note the color of the gel to determine if it has been completely spent; make a notation of its condition. Transfer the silica gel back to its original container and seal. A funnel may make it easier to pour the silica gel without spilling, and a rubber policeman may be used as an aid in removing the silica gel. It is not necessary to remove the small amount of dust particles that may adhere to the walls and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, follow the procedure for Container No. 3 under "Analysis."

Condenser Water. Treat the condenser or impinger water as follows: make a notation of any color or film in the liquid catch. Measure the liquid volume to within ±1 ml by using a graduated cylinder or, if a balance is available, determine the liquid weight to within ±0.5 g. Record the total volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas. Discard the liquid after measuring and recording the volume or weight.

4.3 Analysis. Record the data required on the example sheet shown in Figure 17-4. Handle each sample container as follows:

Container No. 1. Leave the contents in the shipping container or transfer the filter and any loose particulate from the sample container to a tared glass weighing dish. Desiccate for 24 hours in a desiccator containing anhydrous calcium sulfate. Weigh to a constant weight and report the results to the nearest 0.1 mg. For purposes of this Section, 4.3, the term "constant weight" means a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of desiccation time between weighings.

Alternatively, the sample may be oven dried at the average stack temperature or 105°C (220°F), whichever is less, for 2 to 3

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Alternatively, the sample may be oven dried at the average stack temperature or 105°C (220°F), whichever is less, for 2 to 3

105°C (220°F), whichever is less, for 2 to 3 hours, weigh the sample, and use this weight as a final weight.

Plant _____

Date _____

Run No. _____

Filter No. _____

Amount liquid lost during transport _____

Acetone blank volume, ml _____

Acetone wash volume, ml _____

Acetone black concentration, mg/mg (equation 17-4) _____

Acetone wash blank, mg (equation 17-5) _____

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
TOTAL			
		Less acetone blank	
		Weight of particulate matter	

	VOLUME OF LIQUID WATER COLLECTED		
	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g	
FINAL			
INITIAL			
LIQUID COLLECTED			
TOTAL VOLUME COLLECTED		g*	ml

* CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER (1g/ml).

$$\frac{\text{INCREASE, g}}{\text{1 g/ml}} = \text{VOLUME WATER, ml}$$

Figure 17-4. Analytical data.

hours, cooled in the desiccator, and weighed to a constant weight, unless otherwise specified by the Control Agency's Authorized Representative. The tester may also opt to oven dry the sample at the average stack temperature or 105°C (220°F), whichever is less, for 2 to 3 hours, weigh the sample, and use this weight as a final weight.

Container No. 2. Note the level of liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Control Agency's Authorized Representative , to correct the final results. Measure the liquid in this container either volumetrically to ±1 ml or gravimetrically to ±0.5 g. Transfer the contents to a tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

Container No. 3. This step may be conducted in the field. Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance.

"Acetone Blank" Container. Measure acetone in this container either volumetrically or gravimetrically. Transfer the acetone to a tared 250-ml beaker and evaporate to dryness at ambient temperature and

hours, cooled in the desiccator, and weighed to a constant weight, unless otherwise specified by the Control Agency's Authorized Representative. The tester may also opt to oven dry the sample at the average stack temperature or 105°C (220°F), whichever is less, for 2 to 3 hours, weigh the sample, and use this weight as a final weight.

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pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

NOTE: At the option of the tester, the contents of Container No. 2 as well as the acetone blank container may be evaporated at temperatures higher than ambient. If evaporation is done at an elevated temperature, the temperature must be below the boiling point of the solvent; also, to prevent "bumping," the evaporation process must be closely supervised, and the contents of the beaker must be swirled occasionally to maintain an even temperature. Use extreme care, as acetone is highly flammable and has a low flash point.

5. Calibration

Maintain a laboratory log of all calibrations.

5.1 Probe Nozzle. Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the inside diameter of the nozzle to the nearest 0.025 mm (0.001 in). Make three separate measurements using different diameters each time, and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identified.

5.2 Pitot Tube. If the pitot tube is placed in an interference-free arrangement with respect to the other probe assembly components, its baseline (isolated tube) coefficient shall be determined as outlined in Section 4 of Method 2. If the probe assembly is not interference-free, the pitot tube assembly coefficient shall be determined by calibration, using methods subject to the approval of the Control Agency's Authorized Representative.

5.3 Metering System. Before its initial use in the field, the metering system shall be calibrated according to the procedure outlined in APTD-0576. Instead of physically adjusting the dry gas meter dial readings to correspond to the wet test meter readings, calibration factors may be used to mathematically correct the gas meter dial readings to the proper values.

Before calibrating the metering system, it is suggested that a leak-check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump. For these cases the following leak-check procedure is suggested: make a 10-minute calibration run at 0.00057 m^3/min (0.02 cfm); at the end of the run, take the difference of the measured wet test meter and dry gas meter volumes; divide the difference by 10, to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

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After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test), with the vacuum set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet test meter and the inlet of the metering system. Calculate the average value of the calibration factor. If the calibration has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as outlined in APTD-0576.

Alternative procedures, e.g., using the orifice meter coefficients, may be used, subject to the approval of the Control Agency's Authorized Representative.

NOTE: If the dry gas meter coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using which ever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

5.4 Temperature Gauges. Use the procedure in Section 4.3 of Method 2 to calibrate in-stack temperature gauges. Dial thermometers, such as are used for the dry gas meter and condenser outlet, shall be calibrated against mercury-in-glass thermometers.

5.5 Leak Check of Metering System Shown in Figure 17-1. That portion of the sampling train from the pump to the orifice meter should be leak checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. The following procedure is suggested (see Figure 17-5). Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13 to 18 cm (5 to 7 in) water column by blowing into the rubber tubing. Pinch off the tubing and observe the manometer for one minute. A loss of pressure on the manometer indicates a leak in the meter box, leaks, if present, must be corrected.

5.6 Barometer. Calibrate against a mercury barometer.

6. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used as long as they give equivalent results.

6.1 Nomenclature.

A_n = Cross-sectional area of nozzle, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream, proportion by volume.

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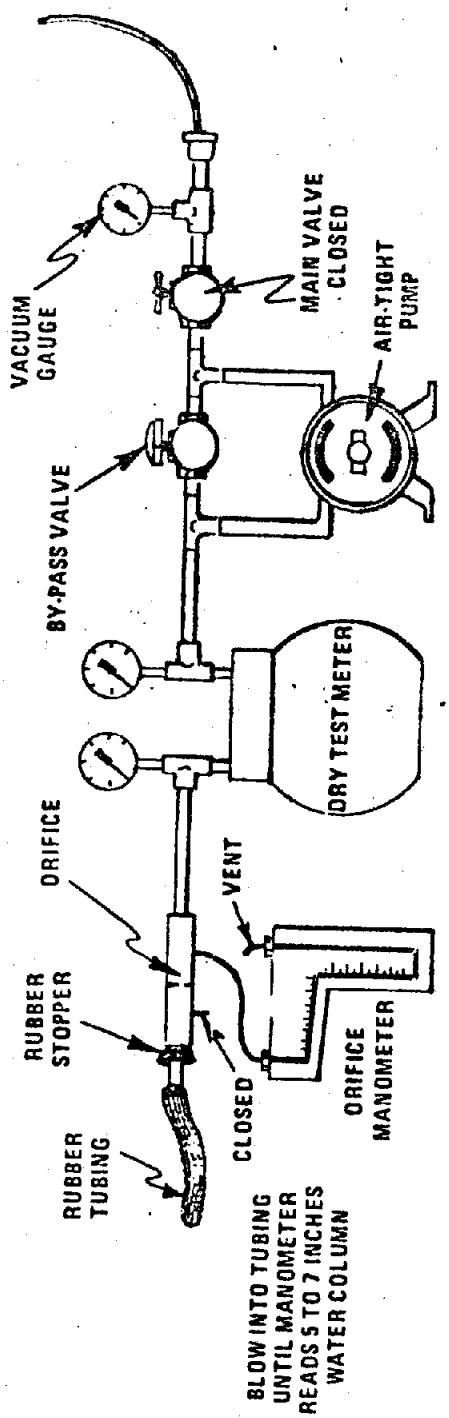

Figure 17-5. Leak check of meter box.

C_a = Acetone blank residue concentration, mg/g.

c_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/sdcf).

I = Percent of isokinetic sampling.

L_a = Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.

L_i = Individual leakage rate observed during the leak check conducted prior to the "ith" component change (i = 1, 2, 3, ...n) m^3/min (cfm).

L_p = Leakage rate observed during the post-test leak check, m^3/min (cfm).

m_n = Total amount of particulate matter collected, mg.

M_W = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

m_a = Mass of residue of acetone after evaporation, mg.

P_{bar} = Barometric pressure at the sampling site, mm Hg (in Hg).

P_s = Absolute stack gas pressure, mm Hg (in Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).

R = Ideal gas constant, 0.06236 mm Hg-$m^3/{}^oK$-g-mole (21.85 in Hg-$ft^3/{}^oR$-lb-mole).

C_a = Acetone blank residue concentration, mg/g.

c_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/sdcf).

I = Percent of isokinetic sampling.

L_a = Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.

L_i = Individual leakage rate observed during the leak check conducted prior to the "ith" component change (i = 1, 2, 3, ...n) m^3/min (cfm).

L_p = Leakage rate observed during the post-test leak check, m^3/min (cfm).

m_n = Total amount of particulate matter collected, mg.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

m_a = Mass of residue of acetone after evaporation, mg.

P_{bar} = Barometric pressure at the sampling site, mm Hg (in Hg).

P_s = Absolute stack gas pressure, mm Hg (in Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).

R = Ideal gas constant, 0.06236 mm Hg-$m^3/{}^oK$-g-mole (21.85 in Hg-$ft^3/{}^oR$-lb-mole).

T_m = Absolute average dry gas meter temperature (see Figure 17-3, ^oK (^oR).

T_s = Absolute average stack gas temperature (see Figure 17-3, ^oK (^oR).

$T_{(std)}$ = Standard absolute temperature, 293^oK (528^oR).

V_a = Volume of acetone blank, ml.

V_{aw} = Volume of acetone used in wash, ml.

V_{lc} = Total volume of liquid collected in impingers and silica gel (see Figure 17-4), ml.

V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Volume of gas sample as measured by dry gas meter, corrected to standard conditions, dcm (dcf).

$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).

v_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 17, m/sec (ft/sec).

W_a = Weight of residue in acetone wash, mg.

Y = Dry gas meter calibration coefficient.

ΔH = Average pressure differential across the orifice meter (see Figure 17-3), mm H_2O (in H_2O).

p_a = Density of acetone, mg/ml (see label on bottle).

p_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

θ = Total sampling time, min.

θ_i = Sampling time interval, from the beginning of a run until the first component change, min.

θ_1 = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.

θ_p = Sampling time interval, from the final (nth) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 17-3).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C, 760 mm Hg or 68°F, 29.92 in Hg) by using Equation 17-1.

$$V_{m(std)} = V_m Y \left[\frac{T_{std}}{T_m}\right]\left[\frac{P_{bar} + \Delta H/13.6}{P_{std}}\right]$$

$$= K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 17-1

where:

K_1 = 0.3858° K/mm Hg for metric units; 17.65° R/in Hg for English units.

θ_i = Sampling time interval, from the beginning of a run until the first component change, min.

θ_l = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.

θ_p = Sampling time interval, from the final (nth) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 17-3).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C, 760 mm Hg or 68°F, 29.92 in Hg) by using Equation 17-1.

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$$= K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 17-1

where:

K_1 = 0.3858° K/mm Hg for metric units; 17.65° R/in Hg for English units.

NOTE: Equation 17-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds L_a. If L_p or L_i exceeds L_a, Equation 17-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace V_m in Equation 17-1 with the expressions:

$$[V_m - (L_p - L_a)\theta]$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace V_m in Equation 17-1 by the expression:

$$[V_m - (L_1-L_a)\theta_1 - \sum_{i=2}^{n}(L_i-L_a)\theta_i - (L_p-L_a)\theta_p]$$

and substitute only for those leakage rates (L_i or L_p) which exceed L_a.

6.4 Volume of Water Vapor.

$$V_{w(std)} = V_{lc}\left[\frac{P_w}{M_w}\right]\left[\frac{RT_{std}}{P_{std}}\right] = K_2 V_{lc}$$

Equation 17-2

where:

K_2 = 0.001333 m^3/ml for metric units; 0.04707 ft^3/ml for English units.

6.5 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

Equation 17-3

6.6 Acetone Blank Concentration.

$$C_a = \frac{m_a}{V_a \quad p_a}$$

Equation 17-4

6.7 Acetone Wash Blank.

$$W_a = C_a V_a w p_a$$

Equation 17-5

6.8 Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from containers 1 and 2 less the acetone blank (see Figure 17-4).

NOTE: Refer to Section 4.1.5 to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

6.9 Particulate Concentration.

$$c_s = (0.001 \text{ g/mg}) (m_n/V_{m(std)})$$

Equation 17-6

6.10 Conversion Factors:

From	To	Multiply by
scf	m^3	0.02832
g/ft^3	gr/ft^3	15.43
g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.31

6.6 Acetone Blank Concentration.

$$C_a = \frac{m_a}{V_a \quad p_a}$$

Equation 17-4

6.7 Acetone Wash Blank.

$$W_a = C_a V_a w p_a$$

Equation 17-5

6.8 Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from containers 1 and 2 less the acetone blank (see Figure 17-4).

NOTE: Refer to Section 4.1.5 to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

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g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.31

6.11 Isokinetic Variation.

6.11.1 Calculation from Raw Data.

$$I = \frac{100\ T_s\ [K_3 V_{lc} + (V_m Y / T_m)(P_{bar} + \Delta H/13.6)]}{60\ \theta v_s\ P_s\ A_n}$$

Equation 17-7

where:

K_3 = 0.003454 mm Hg-m^3/ml-^oK for metric units;

0.002669 in.Hg-ft^3/ml-^oR for English units.

6.11.2 Calculation from Intermediate Values.

$$I = \frac{T_s\ V_{m(std)}\ P_{std}\ 100}{T_{std}\ v_s\ \theta\ A_n\ P_s\ 60\ (1-B_{ws})}$$

$$= K_4 \frac{T_s\ V_{m(std)}}{P_s\ v_s\ A_n\ \theta\ (1-B_{ws})}$$

Equation 17-8

where:

K_4 = 4.320 for metric units; 0.09450 for English units.

6.12 Acceptable Results. If 90 percent $\leq I \leq$ 110 percent, the results are acceptable. If the results are low in comparison to the standard and I is beyond the acceptable range, or, if I is less than 90 percent, the Control Agency's Authorized Representative may opt to accept the results. Otherwise, reject the results and repeat the test.

7. Bibliography

1. Addendum to Specifications for Incinerator Testing at Federal Facilities. PHS, NCAPC. December 6, 1967.

2. Martin, Robert M., Construction Details of Isokinetic Source-Sampling Equipment. Environmental Protection Agency. Research Triangle Park, NC. APTD-0581. April 1971.

3. Rom, Jerome J. Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment. Environmental Protection Agency. Research Triangle Park, NC. APTD-0576. March, 1972.

4. Smith, W.S., R.T. Shigehara, and W.F. Todd. A Method of Interpreting Stack Sampling Data. Paper Presented at the 63rd Annual Meeting of the Air Pollution Control Association, St. Louis, MO. June 14-19, 1970.

5. Smith, W.S., et al., Stack Gas Sampling Improved and Simplified with New Equipment. APCA Paper No. 67-119. 1967.

6. Specifications for Incinerator Testing at Federal Facilities. PHS, NCAPC. 1967.

7. Shigehara, R.T. Adjustments in the EPA Nomograph for Different Pitot Tube Coefficients and Dry Molecular Weights. Stack Sampling News 2:4-11. October, 1974.

8. Vollaro, R.F. A Survey of Commercially Available Instrumentation for the Measurement of Low-Range Gas Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch. Research Triangle Park, NC. November, 1976 (unpublished paper).

9. Annual Book of ASTM Standards. Part 26. Gaseous Fuels; Coal and Coke; Atmospheric Analysis. American Society for Testing and Materials. Philadelphia, PA. 1974. pp. 617-622.

10. Vollaro, R.F. Recommended Procedure for Sample Traverses in Ducts Smaller than 12 Inches in Diameter. U.S. Environmental Protection Agency, Emission Measurement Branch. Research Triangle Park, NC. November, 1976.

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7. Shigehara, R.T. Adjustments in the EPA Nomograph for Different Pitot Tube Coefficients and Dry Molecular Weights. Stack Sampling News 2:4-11. October, 1974.

8. Vollaro, R.F. A Survey of Commercially Available Instrumentation for the Measurement of Low-Range Gas Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch. Research Triangle Park, NC. November, 1976 (unpublished paper).

9. Annual Book of ASTM Standards. Part 26. Gaseous Fuels; Coal and Coke; Atmospheric Analysis. American Society for Testing and Materials. Philadelphia, PA. 1974. pp. 617-622.

10. Vollaro, R.F. Recommended Procedure for Sample Traverses in Ducts Smaller than 12 Inches in Diameter. U.S. Environmental Protection Agency, Emission Measurement Branch. Research Triangle Park, NC. November, 1976.

METHOD 100 - PROCEDURES FOR CONTINUOUS GASEOUS EMISSION STACK SAMPLING

1. Principle and Applicability

1.1 Principle: A sample of an exhaust gas stream is extracted, conditioned and analyzed continuously by instruments. The measurements made by the continuous analyzers are used to determine average emission concentrations. By measuring the stack gas flowrate and using this information with the average emission concentration mass emission rates can be determined:

1.2 Applicability: This method is applicable for determining emissions of Oxides of Nitrogen, Carbon Monoxide, Carbon Dioxide, Sulfur Dioxide, Total Hydrocarbons, and Oxygen from stationary source flowing gas streams in ducts, stacks and flues except for turbine engines and stationary diesel engines. This procedure does not supercede the New Source Performance Standards requirement for permanently installed continuous monitoring instruments.

This test procedure is an alternative method to appropriate U.S. EPA reference methods, in particular EPA methods 3, 6, 7 and 10. This procedure should be used only on those sources where equivalency to the reference methods has been established or the specific regulations for the source specify this procedure.

FIGURE 1-1

Example - PITOT TUBE - SAMPLE PROBE ASSEMBLY

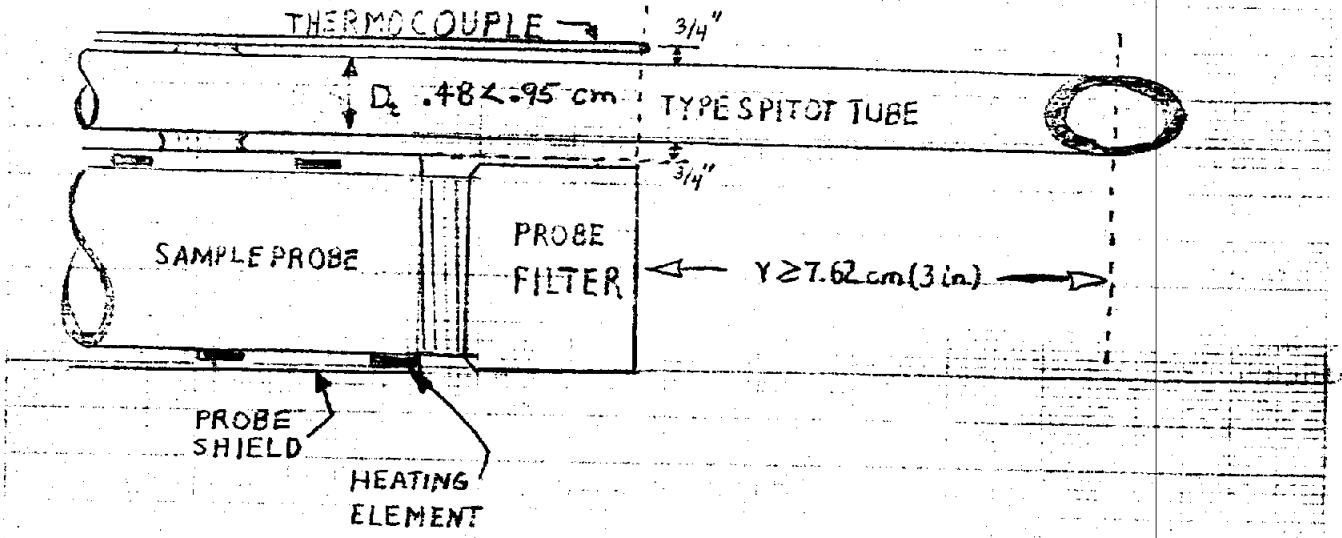

FIGURE 1-2

Example - SAMPLE TRAIN ASSEMBLY

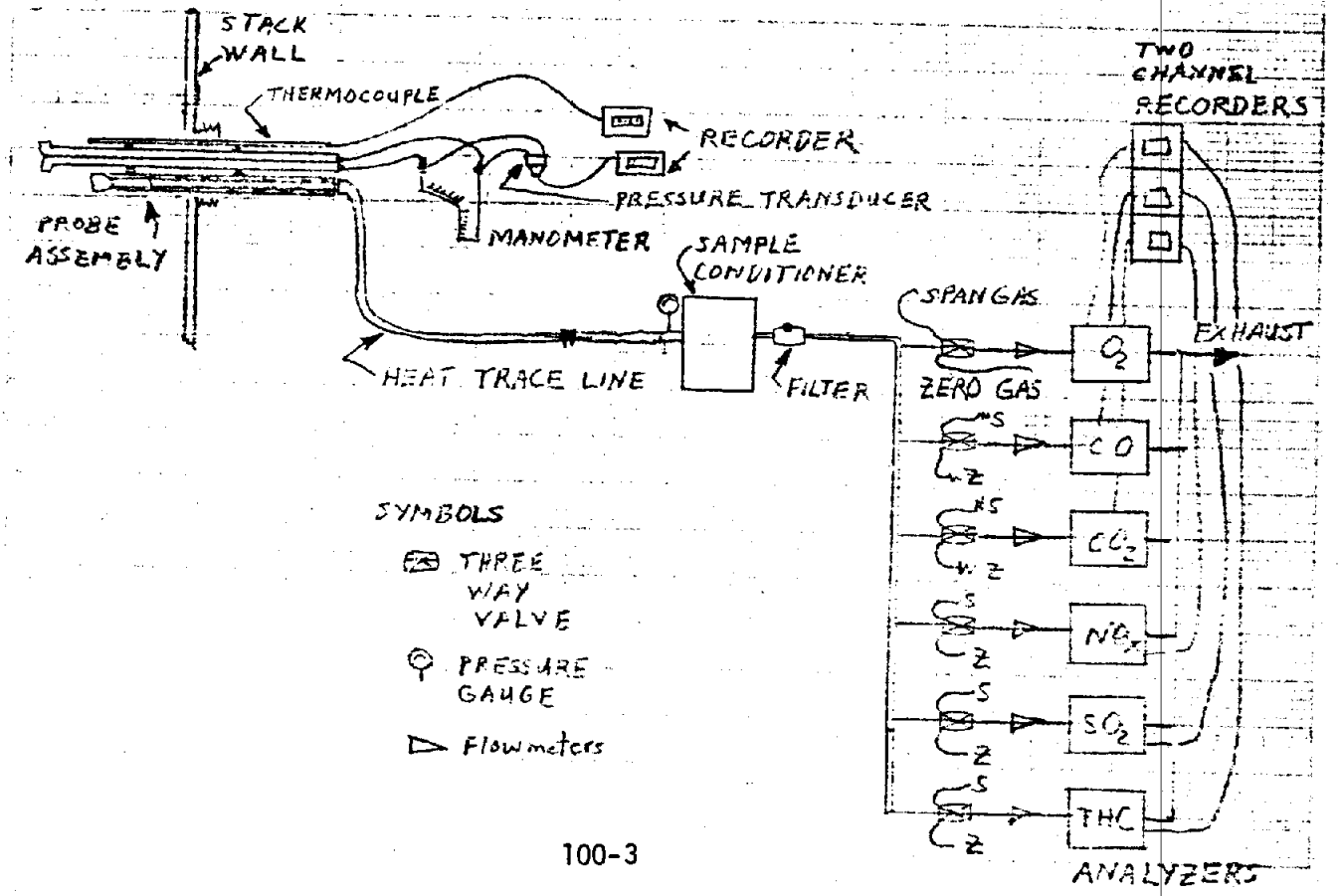

Figure 2

State of California

AIR RESOURCES BOARD

Engineering Evaluation Branch
Testing Section

SUMMARY OF TEST DATA

COMPANY: _____ ADDRESS: _____

POLLUTANT TESTED: _____ TEST METHOD: _____ ITEM TESTED: _____ TESTED BY: _____ DATE TESTED: _____

TIME	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
HOURLY AVG.																								
HIGH MIN. AVG:																								
NO. OF VIOLATIONS:																								
CORRECTED TO:																								
CONCENTRATIONS: SCALE:																								

REMARKS:

Figure 2

State of California

AIR RESOURCES BOARD

Engineering Evaluation Branch
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SUMMARY OF TEST DATA

COMPANY: _____ ADDRESS: _____

POLLUTANT TESTED: _____ TEST METHOD: _____ ITEM TESTED: _____ TESTED BY: _____ DATE TESTED: _____

TIME	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
HOURLY AVG.																								
HIGH MIN. AVG:																								
NO. OF VIOLATIONS:																								
CORRECTED TO:																								
CONCENTRATIONS: SCALE:																								

REMARKS:

100-4

Alternatively, sample line made from other material (equivalent or better) may be used subject to the approval of the Control Agency's authorized representative.

2.1.4 Sample Conditioner: General specifications; filter, 90 percent efficient to 0.3 micron, glass fiber is acceptable; capable of reducing moisture content of sample to below the dewpoint 68°F (20°C); all parts, with the exception of the filter, exposed to the sample shall either be glass, stainless steel or teflon. Refrigeration type conditioners shall be equipped with a metal bellow or teflon lined diaphram pump capable of 40 cfh. . . Provisions shall be made for back flushing through the sample line from the sample conditioner through the probe for removing particulate buildup on the probe nozzle.

When sampling hydrocarbons C_3 and above it is recommended that heated line be used from the source to the hydrocarbon analyzer, that all filters be heated, and that no sample conditioning be performed that lowers sample temperature.

2.2 Carbon Dioxide and Carbon Monoxide: Nondispersive infrared analyzers are acceptable. See Table I for specifications.

2.3 Oxygen: A paramagnetic analyzer is acceptable. See Table I for specifications.

Table 1
ANALYZER SPECIFICATIONS FOR SOURCE SAMPLING

	Typical Principle of Operation 1/	Typical Range or Ranges PPM	Minimum Detectable Sensitivity PPM	Noise Level % of Full Scale (peak to peak)	Response Time Time Interval from a step Change in Input Conc. at Inlet to Instrument Output Reading of 90% of Steady State	Zero Drift Change in Instrument Output After 24 hours of Unadjusted Continuous Operation Change % of Full Scale	Calibration or Span Drift in Instrument After 24 Hours of Unadjusted Continuous Opert. Change % of Full Sale	Precision Maximum Ave. Deviation From Mean Change % of Full Sale	Operating Temperature or Range	Linearity Maximum % Deviation Between any Two Range Settings
Sulfur Dioxide	Photometric measurement of absorption of SO_2 radiation when subjected to ultraviolet light	0 – 300 0 – 3000	.10	<± 1% HT Range <± 2% Lo Range	< 10 secs.	<± 1.	± 2.0	± 2% on all scales	0 to 50°C	± 1
Oxides of Nitrogen	Photometric measurement of the chemilum-inescence from the reaction of NO with ozone	0 – 25 0 – 100 0 – 250 0 – 1000 0 – 2500	2	<± 1%	10 secs.	<± 1%	< 2.0	± 2% on all scales	0 to 50°C	± 1
Hydrogen Sulfide	Photometric measurement of the chemilum-inescence from the reaction of H_2S with ozone	0 – 5; 0 – 12.5 0 – 125 0 – 500 0 – 1250 0 – 5000	1	<±1%	< 10secs.	<± 1%	< 2.0	± 2% on all scales	0 to 50°C	± 1
Carbon Monoxide	Non-dispersive infra-red absorption	0 – 1000 0 – 5000	10	<± 1%	< 60 secs	<± 1%	<± 2.0	± 2% on all scales	0 to 50°C	± 1
Carbon Dioxide	Non-dispersive infra-red absorption	0 – 5% 0 – 50%	1% of instrument scale	<± 1%	< 60 secs	<± 1%	<± 2.0	± 2% on all scales	0 to 50°C	± 1
Hydro-carbons	Flame ionization method of detection	0 – 10 0 – 100 0 – 1000 0 – 10,000 0 – 100,000	1 to 2 ppm Methane	<± 1%	< 10	<± 1%	± 2	± 2% on all scales	0 – 60°C	± 1
Oxygen	Uses the paramagnetic properties of oxygen	0 – 5% 0 – 10% 0 – 25%	.01%	<± 1%	< 60 secs.	<± 1%	± 2	± 1% of full scale	0 to 50°C	± 1

1/ Other types will also be acceptable.

Table 1
ANALYZER SPECIFICATIONS FOR SOURCE SAMPLING

	Typical Principle of Operation 1/	Typical Range or Ranges PPM	Minimum Detectable Sensitivity PPM	Noise Level % of Full Scale (peak to peak)	Response Time, Time Interval from a step Change in Input Conc. at Inlet to Instrument Output Reading of 90% of Steady State	Zero Drift Change in Instrument Output After 24 hours of Unadjusted Continuous Operation Change % of Full Scale	Calibration or Span Drift in Instrument After 24 Hours of Unadjusted Continuous Opert. Change % of Full Sale	Precision Maximum Ave. Deviation From Mean Change % of Full Sale	Operating Temperature or Range	Linearity Maximum % Deviation Between any Two Range Settings
Sulfur Dioxide	Photometric measurement of absorption of SO_2 radiation when subjected to ultraviolet light	0 – 300 0 – 3000	10	<± 1% HI Range <± 2% Lo Range	< 10 secs.	<± 1.	± 2.0	± 2% on all scales	0 to 50°C	± 1
Oxides of Nitrogen	Photometric measurement of the chemiluminescence from the reaction of NO with ozone	0 – 25 0 – 100 0 – 250 0 – 1000 0 – 2500	2	<± 1%	10 secs.	<± 1%	< 2.0	± 2% on all scales	0 to 50°C	± 1
Hydrogen Sulfide	Photometric measurement of the chemiluminescence from the reaction of of H_2S with ozone	0 – 5; 0 – 12.5 0 – 125 0 – 500 0 – 1250 0 – 5000	1	<±1%	< 10secs.	<± 1%	< 2.0	± 2% on all scales	0 to 50°C	± 1
Carbon Monoxide	Non-dispersive infra-red absorption	0 – 1000 0 – 5000	10	<± 1%	< 60 secs	<± 1%	<± 2.0	± 2% on all scales	0 to 50°C	± 1
Carbon Dioxide	Non-dispersive infra-red absorption	0 – 5% 0 – 50%	1% of instrument scale	<± 1%	< 60 secs	<± 1%	<± 2.0	± 2% on all scales	0 to 50°C	± 1
Hydro-carbons	Flame ionization method of detection	0 – 10 0 – 100 0 – 1000 0 – 10,000 0 - 100,000	1 to 2 ppm Methane	<± 1%	< 10	<± 1%	± 2	± 2% on all scales	0 – 60°C	± 1
Oxygen	Uses the paramagnetic properties of oxygen	0 – 5% 0 – 10% 0 – 25%	.01%	<± 1%	< 60 secs.	<± 1%	± 2	± 1% of full scale	0 to 50°C	± 1

1/ Other types will also be acceptable.

2.4 Total Hydrocarbons: An analyzer using a flame ionization detector (FID) is acceptable. See Table I for specifications. (Note: The FID may not be acceptable for detecting certain organic compounds.)

2.5 Oxides of Nitrogen: An analyzer using chemiluminescent is acceptable. See Table I for specifications.

2.6 Sulfur Dioxide: An analyzer using ultraviolet absorption is acceptable. See Table I for specifications.

2.7 Other analyzers and measurement principles may be used, if their performance capability is equivalent to those referenced (see Q.A. Manual). An analyzer with more than a five percent interference from substances present in the sample stream (other than what is being measured) should not be used for the application.

2.8 Recorders: Shall be compatible with analyzers and employing strip chart paper with 100 divisions minimum.

2.9 Pitot tube. Same as required by Methods 1 and 2.

2.10 Differential pressure guage. Same as required by Methods 1 and 2.

2.11 For determining water moisture content the equipment shall be as specified by Method 4.

2.12 Barometer. Mercury, Aneroid, or other barometer capable of measuring atmosphereic pressure to within 2.5 mm Hg.

2.13 Vacuum guage. 760 mm Hg. guage, to be used for leak check of sampling train.

2.14 Thermocouple. Suitable for temperature range expected in the stack gases.

2.15 Calibration Gases

Zero Gas: Pure air or if appropriate nitrogen with less than 1 ppm of appropriate pollutant gas.

Span Gases: For each pollutant to be measured use one calibration gas in the expected concentration range. The calibration gas should be approximately 70 to 80 percent of the analyzer range and the expected maximum concentration to be measured should be no more than 90 percent of the range. The calibration gases used must be traceable to a primary standard (NBS standards if available).

3. Reagents

3.1 Distilled water: Distilled, deionized.

2.11 For determining water moisture content the equipment shall be as specified by Method 4.

2.12 Barometer. Mercury, Aneroid, or other barometer capable of measuring atmosphereic pressure to within 2.5 mm Hg.

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Zero Gas: Pure air or if appropriate nitrogen with less than 1 ppm of appropriate pollutant gas.

Span Gases: For each pollutant to be measured use one calibration gas in the expected concentration range. The calibration gas should be approximately 70 to 80 percent of the analyzer range and the expected maximum concentration to be measured should be no more than 90 percent of the range. The calibration gases used must be traceable to a primary standard (NBS standards if available).

3. Reagents

3.1 Distilled water: Distilled, deionized.

3.2 Acetone: Reagent grade

4. Preparation for Sampling

4.1 Cleaning of Sample Train: Thoroughly flush probe, heat trace line and sample conditioner with distilled water, followed by acetone, and dry with filtered dry air.

4.2 Continuous Analyzers: Allow analyzers to warm up according to manufacturer's instructions and performance check the analyzers in accordance with the manufacturers operator manual and conduct a zero and span check using a span gas of approximately 70 to 80 percent of the instrument range. Record data. The analyzer range should be selected such that the maximum concentration measured is no more than 90 percent of the range and the minimum concentration measured is no less than 30 percent of the range.

4.3 Sample Train Assembly: Assemble the sample train as shown in Figure 1.2. Lake check the vacuum side of the assembly (minus nozzle filter) to 15 inches of Hg. (guage). If the leak is equal to more than 0.20 CFH (94.ml/min) or is in excess of one percent of average sampling rate, check for leaks, correct any found and redo leak check. Repeat until a satisfactory result is obtained. Check pressure side of system with liquid Snoop or equivalent and correct any leaks. Alternate leak check methods are acceptable if they are equivalent or better than the specified method.

Sample train assembly can be modified to reflect actual stack conditions. Permissible modifications include: (1) If stack is at or below ambient temperature and there is no condensation problem, the heating element and sample conditioner can be eliminated. (2) If condensation in the probe itself is not a problem, the probe heating element can be eliminated. (3) If the only concern is with concentration, the pitot tube can be eliminated. (4) If stack temperature is uniform with time, the thermocouple can be eliminated.

5. Sampling

5.1 Select traverse points (only 1/3 number points, every third one, required as compared to particulate matter test Method 5) and determine moisture content and velocity pressures in the stack gases in accordance with Methods 1-1, 1-2 and 1-4. If sampling location meets criteria of eight diameters downstream and two diameters upstream of a disturbance and/or there is no reason to suspect stratification (stratification effects can be ignored if concentration variation is less than 10 percent) in the gas stream, select a convenient sampling point or a point at the point of average stack velocity (probe nozzle should never be within one inch of stack wall).

Sample train assembly can be modified to reflect actual stack conditions. Permissible modifications include: (1) If stack is at or below ambient temperature and there is no condensation problem, the heating element and sample conditioner can be eliminated. (2) If condensation in the probe itself is not a problem, the probe heating element can be eliminated. (3) If the only concern is with concentration, the pitot tube can be eliminated. (4) If stack temperature is uniform with time, the thermocouple can be eliminated.

5. Sampling

5.1 Select traverse points (only 1/3 number points, every third one, required as compared to particulate matter test Method 5) and determine moisture content and velocity pressures in the stack gases in accordance with Methods 1-1, 1-2 and 1-4. If sampling location meets criteria of eight diameters downstream and two diameters upstream of a disturbance and/or there is no reason to suspect stratification (stratification effects can be ignored if concentration variation is less than 10 percent) in the gas stream, select a convenient sampling point or a point at the point of average stack velocity (probe nozzle should never be within one inch of stack wall).

5.2 Turn on strip chart recorder so that hour coincides with division on strip chart (for one channel with dual pen recorders). Identify pollutant, source, range, calibration cylinder I.D. number, zero and span settings, chart speeds, date, time, person operating instruments on the chart, and any other pertinent data.

5.3 Insert sample probe assembly into stack and block-off remainer of opening. Set probe at predetermined position and note on strip charts. If traverse is required, leave probe in position for three to five minutes (allow enough time for system to be flushed and instruments to respond fully). Move probe to next position and repeat. Continue until stack has been fully traversed. Record data on summary sheet (Figure 100-3). From data, select point of average concentration and/or velocity. Set probe at this point.

5.4 With probe at average point, sample for desired time period without further adjustments. Sampling should be conducted for a minimum of two hours. Conduct zero and span checks every hour, adjust settings as necessary, mark strip charts and record in log books. When zero and span checks repeat within one percent, make checks every six hours. As necessary back flush through probe every two hours to prevent particulate build-up on probe filter. The strip chart should be marked to indicate time on an hourly basis.

At end of sample period, make final zero and span check and mark charts and record data. If velocity at end of test is 50 percent different from at start or concentrations have changed by 100 percent, repeat traverse as indicated in 5.3.

5.5 Repeat leak check. If leak rate is two percent or more of total sample flow (approximately 0.8 CFH) discard test.

6. Calculations

6.1 Emission Rate, lbs/hr. lbs of Pollutant/Hr. =

$$(PPM)\left(\frac{M}{385 \times 10^6}\right)(Q)\ (60) = PPM \times M \times Q \times 1.56 \times 10^{-7}$$

Where: M = molecular weight - lb/lb mole.

385×10^6 = Constant

Q = standard dry cubic feet per minute of stack effluents

$$Q = Qs \times \frac{Tstd\ Ps}{Ts\ Pstd}\ (1 - Bws) = Qs\left(\frac{528}{Ts}\right)\left(\frac{Ps}{29.92}\right)\ (1 - Bws)$$

$$= 17.65\ \frac{Qs\ Ps}{Ts}\ (1 - Bws)$$

B_{ws} = percent water vapor in effluent stream

SUBSCRIPTS

s = stack conditions

std - standard condition

6.2 Percent Excess Air (EA)

At end of sample period, make final zero and span check and mark charts and record data. If velocity at end of test is 50 percent different from at start or concentrations have changed by 100 percent, repeat traverse as indicated in 5.3.

5.5 Repeat leak check. If leak rate is two percent or more of total sample flow (approximately 0.8 CFH) discard test.

6. Calculations

6.1 Emission Rate, lbs/hr. lbs of Pollutant/Hr. =

$$(PPM)\left(\frac{M}{385 \times 10^6}\right)(Q)\ (60) = PPM \times M \times Q \times 1.56 \times 10^{-7}$$

Where: M = molecular weight - lb/lb mole.

385×10^6 = Constant

Q = standard dry cubic feet per minute of stack effluents

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$$= 17.65\ \frac{Qs\ Ps}{Ts}\ (1 - Bws)$$

B_{ws} = percent water vapor in effluent stream

SUBSCRIPTS

s = stack conditions

std - standard condition

6.2 Percent Excess Air (EA)

$$\% EA = \left[\frac{\%O2 - 0.5\% CO}{0.264\ \%N_2 - (\%O_2 - 0.5\% CO)} \right] 100$$

Where: $\%O_2$ = Percent O_2 by volume (dry basis)

$\%CO$ = Percent CO by volume (dry basis)

$\%N_2$ = Percent N_2 by volume (dry basis)

.264 = Ratio of O_2 to N_2 in air v/v

6.3 Pollutant Concentration Calculated to 12% CO_2 or 3% O_2

For 12% CO_2:

$$\text{Conc}_{(12\%\ CO_2)} = \text{Conc.}_{(\text{Std.})} \times \frac{12\%}{\%\ CO_2 \text{ during test (dry basis)}}$$

For 3% O_2 using O_2 in air as 20.9%

$$\text{Conc.}_{(3\%\ O_2)} = \text{Conc.}_{(\text{std.})} \times \frac{20.9 \times 3.0}{20.9 - \%O_2 \text{ during test (dry basis)}}$$

7.0 Calibrations

All calibrations are to be performed in accordance with the Air Resources Board "Source Testing Quality Assurance and Quality Control Manual Vol. VI."

195S/033H

METHOD 1-104 - REFERENCE METHOD FOR DETERMINATION OF BERYLLIUM EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability:

   1.1 Principle: Beryllium emissions are isokinetically sampled from the source, and the collected sample is digested in an acid solution and analyzed by atomic absorption spectrophotometry.

   1.2 Applicability: This method is applicable for the determination of beryllium emissions in ducts or stacks at stationary sources. Unless otherwise specified, this method is not intended to apply to gas streams other than those emitted directly to the atmosphere without further processing.

2. Apparatus:

   2.1 Sampling Train. A schematic of the sampling train used by EPA is shown in Figure 104-1. Commercial models of this train are available, although construction details are described in APTD-0581,[1/] and operating and maintenance procedures are described in APTD-0576. The components essential to this sampling train are the following:

[1/] These documents are available for a nominal cost from the National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22151.

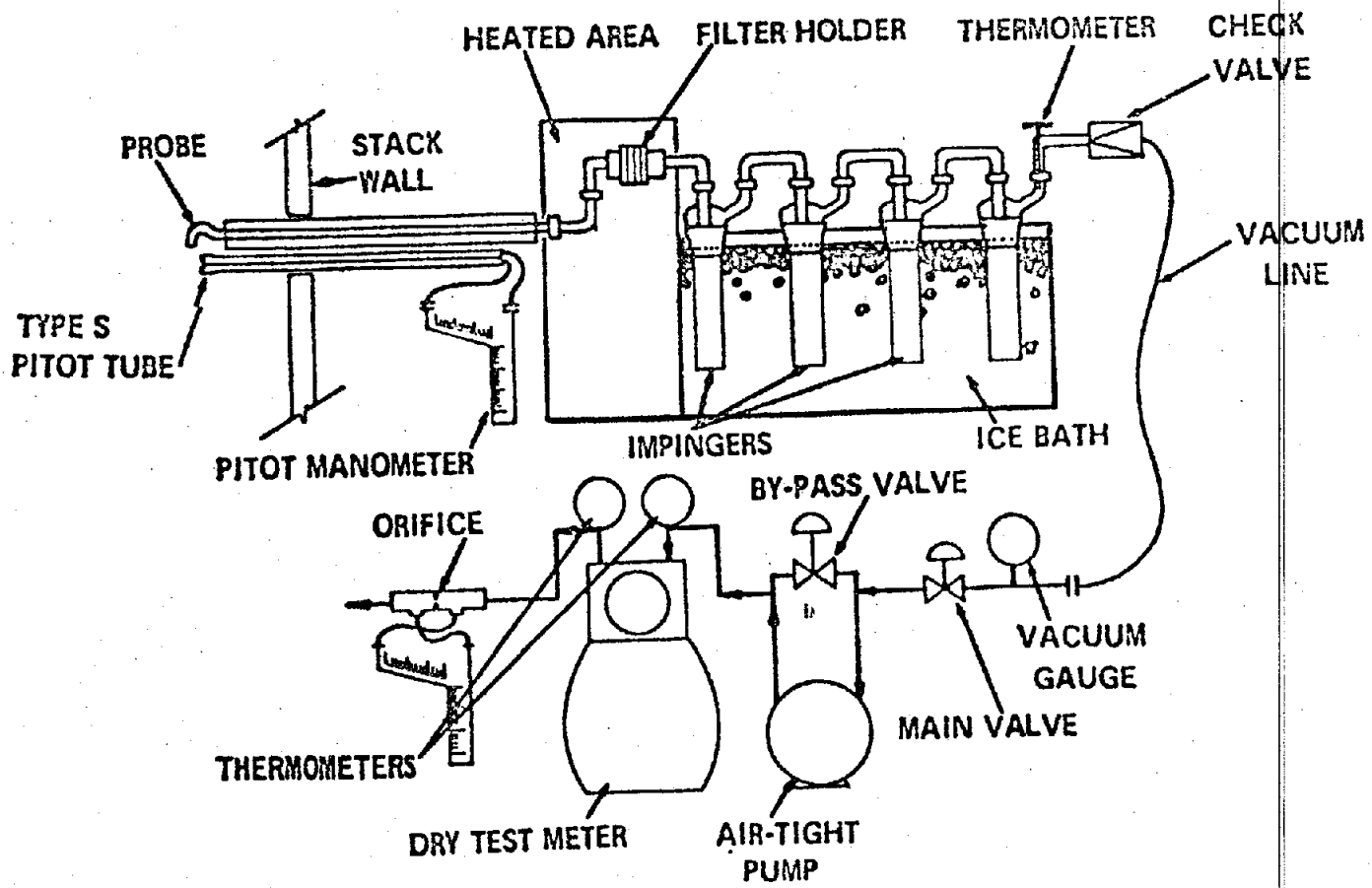

Figure 104-1. Beryllium sampling train

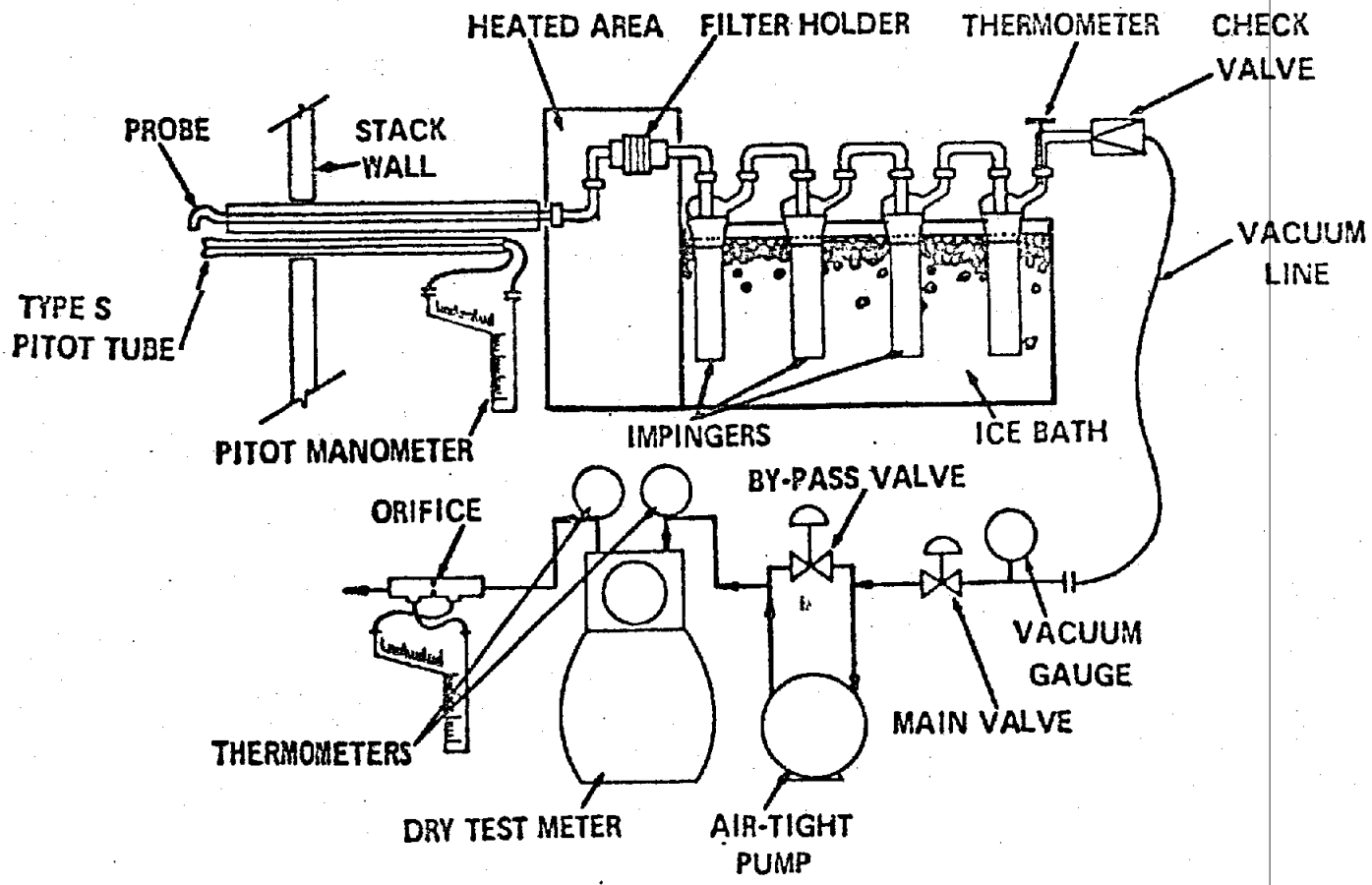

Figure 104-1. Beryllium sampling train

2.1.1 Nozzle. Stainless steel or glass with sharp, tapered leading edge.

2.1.2 Probe. Sheathed Pyrex[2/] glass. A heating system capable of maintaining a minimum gas temperature in the range of the stack temperature at the probe outlet during sampling may be used to prevent condensation from occurring.

2.1.3 Pitot tube. Type S (Figure 104-2), or equivalent, with a coefficient within 5 percent over the working range, attached to probe to monitor stack gas velocity.

2.1.4 Filter holder. Pyrex glass. the filter holder must provide a positive seal against leakage from outside or around the filter. A heating system capable of maintaining the filter at a minimum temperature in the range of the stack temperature may be used to prevent condensation from occurring.

2.1.5 Impingers. Four Greenburg-Smith impingers connected in series with glass ball joint fittings. The first, third and fourth impingers may be modified by replacing the tip with a 1/2 inch l.d. glass tube extending to one-half inch from the bottom of the flask.

[2/]Mention of trade names on specific products does not constitute endorsement by the Air Resources Board.

2.1.6 Metering Systems. Vacuum gauge, leakless pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with 2 percent accuracy, and related equipment, described in APTD-0581, to maintain an isokinetic sampling rate and to determine sample volume.

2.1.7 Barometer. To measure atmospheric pressure to ± 0.1 in Hg.

2.2 Measurement of stack conditions (stack pressure, temperature, moisture and velocity).

2.2.1 Pitot tube: Type S, or equivalent, with a coefficient within 5 percent over the working range.

2.2.2 Differential Pressure Gauge. Inclined manometer, or equivalent, to measure velocity head to within 10 percent of the minimum value.

2.2.3 Temperature gauge. Any temperature measuring device to measure stack temperature to within 5°F.

2.2.4 Pressure gauge. Pitot tube and inclined manometer, or equivalent, to measure stack pressure to within 0.1 in Hg.

2.2.5 Moisture determination. Wet and dry bulb therometers, drying tubes, condensers, or equivalent, to determine stack gas moisture content to within 1 percent.

2.3 Sample recovery.

2.3.1 Probe cleaning rod. At least as long as probe.

2.3.2 Leakless glass sample bottles. 500 ml.

2.3.3 Graduated cylinder. 250 ml.

2.3.4 Plastic jar. Approximately 300 ml.

2.4 Analysis

2.4.1 Atomic absorption spectrophotometer. To measure absorbance at 234.8 nm. Perkin Elmer Model 303, or equivalent, with N_2O/acetylene burner.

2.4.2 Hot plate.

2.4.3 Perchloric acid fume hood.

3. Reagents.

3.1 Stock reagents.

3.1.1 Hydrochloric acid concentrated

3.1.2 Perchloric acid. Concentrated, 70 percent.

3.1.3 Nitric acid. Concentrated.

2.3 Sample recovery.

2.3.1 Probe cleaning rod. At least as long as probe.

2.3.2 Leakless glass sample bottles. 500 ml.

2.3.3 Graduated cylinder. 250 ml.

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3.1.2 Perchloric acid. Concentrated, 70 percent.

3.1.3 Nitric acid. Concentrated.

3.1.4 Sulfuric Acid. Concentrated

3.1.5 Distilled and deionized water.

3.1.6 Beryllium powder. 98 percent minimum purity.

3.2 Sampling

3.2.1 Filter. Millipore AA, or equivalent. It is suggested that a Whatman 41 filter be placed immediately against the back side of the millipore filter as a guard against breaking the Millipore filter. In the analysis of the filter, the Whatman 41 filter should be included with the Millipore filter.

3.2.2 Silica gel. Indicating type, 6 to 16 mesh, dried at 350^{0} F for 2 hours.

3.2.3 Distilled and deionized water.

3.3 Sample recovery

3.3.1 Distilled and deionized water.

3.3.2 Acetone. Reagent grade.

3.3.3 Wash acid. 1.1 V/V hydrochloric acid-water

3.4 Analysis.

3.4.1 Sulfuric acid solution, 12 N. Dilute 333 ml of concentrated sulfuric acid 1 to 1 with distilled water.

3.4.2 25 percent V/V hydrochloric acid-water.

3.5 Standard Beryllium Solution

3.5.1 Stock Solution. 1 ug/ml beryllium. Dissolve 10 mg of beryllium in 80 ml of 12 N sulfuric acid solution and dilute to a volume of 1000 ml with distilled water. Dilute a 10 ml aliquot to 100 ml with 25 percent v/v hydrochloric acid, giving a concentration of 1 ug/ml. This dilute stock solution should be prepared fresh daily. Equivalent strength (in beryllium) stock solutions may be prepared from beryllium salts as $BeCl_2$ and $BE(NO_3)_2$ (98 percent minimum purity).

4. Procedure.

4.1 Guidelines for source testing are detailed in the following sections. These guidelines are generally applicable; however, most sample sites differ to some degree and temporary alterations such as stack extensions or expansions often are required to insure the best possible sample site. Further, since beryllium is hazardous, care should be taken to minimize exposure. Finally, since the total quantity of beryillium to be collected is quite small, the test must be carefully conducted to prevent contamination or loss of sample.

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3.4.1 Sulfuric acid solution, 12 N. Dilute 333 ml of concentrated sulfuric acid 1 to 1 with distilled water.

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4.2 Selection of a sampling site and minimum number of traverse points.

4.2.1 Select a suitable sampling site that is as close as practicable to the point of atmospheric emission. If possible stacks smaller than 1 foot in diameter from the following equation:

$$D_e = \frac{2LW}{L + W} \qquad \text{eq. 104-1}$$

where:

D_e = equivalent diameter

L = length

W = Width

4.2.3 When the above sampling site criteria can be met, the minimum number of traverse points is four (4) for stacks 1 foot in diameter or less, eight (8) for stacks larger than 1 foot but 2 feet in diameter or less, and twelve (12) for stacks larger than 2 feet.

4.2.4 Some sampling situations may render the above sampling site criteria impractical. When this is the case choose a convenient sampling location and use Figure 104-3 to determine the minimum number of traverse points. However, use Figure 104-3 only for stacks 1 foot in diameter or larger.

4.2.5 To use Figure 104-3, first measure the distance from the chosen sampling location to the nearest upstream and downstream disturbances. Divide this distance by the diameter or equivalent diameter to determine the distance in terms of pipe diameters. Determine the corresponding number of traverse points for each distance from Figure 104-3. Select the higher of the two numbers of traverse points, or a greater value, such that for circular stacks the number is a multiple of four, and for rectangular stacks the number follows the criteria of Section 4.3.2.

4.2.6 If a selected sampling point is closer than 1 inch from the stack wall, adjust the location of that point to ensure that the sample is taken at least 1 inch away from the wall.

4.3 Cross-sectional layout and location of traverse points.

4.3.1 For circular stacks locate the traverse points on at least two diameters according to Figure 104-4 and Table 104-1. The traverse axes shall divide the stack cross sections into equal parts.

4.3.2 For rectangular stacks divide the cross section into as many equal rectangular areas as traverse points, such that the ratio of the length to the width of the elemental areas is between 1 and 2. Locate the traverse points at the centroid of each equal area according to Figure 104-5.

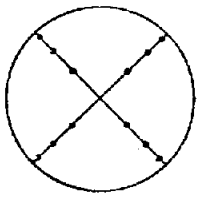

Figure 102-4. Cross section of circular stack showing location of traverse points on perpendicular diameters.

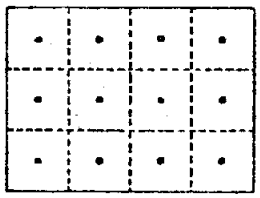

Figure 102-5. Cross section of rectangular stack divided into 12 equal areas, with traverse points at centroid of each area.

TABLE 104-1—LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

[Percent of stack diameter from inside wall to traverse point]

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.5	28.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8				96.7	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.9	67.0
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.9
24												98.9

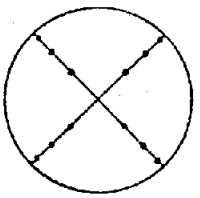

Figure 102-4. Cross section of circular stack showing location of traverse points on perpendicular diameters.

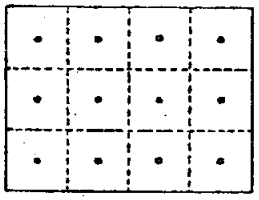

Figure 102-5. Cross section of rectangular stack divided into 12 equal areas, with traverse points at centroid of each area.

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Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8				96.7	85.4	75.0	63.4	37.5	29.6	25.0	21.6	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.5	73.9	67.0
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										95.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.9
24												98.9

4.4 Measurement of stack conditions.

4.4.1 Set up the apparatus as shown in Figure 104-2. Make sure all connections are tight and leak free. Measure the velocity head and temperature at the traverse points specified by Section 4.2 and 4.3.

4.4.2 Measure the static pressure in the stack.

4.4.3 Determine the stack gas moisture.

4.4.4 Determine the stack gas molecular weight from the measured moisture content and knowledge of the expected gas stream composition. A standard Orsat analyzer has been found valuable at combustion sources. In all cases, sound engineering judgment should be used.

4.5 Preparation of a sampling train.

4.5.1 Prior to assembly, clean all glassware (probe, impingers, and connectors) by soaking in wash acid for 2 hours. Place 100 ml of distilled water in each of the first two impingers, leave the third impinger empty, and place approximately 200 g of preweighted silica gel in the fourth impinger. Save a portion of the distilled water as a blank in the sample analysis. Set up the train and the probe as in Figure 104-1.

4.5.2 Leak check the sampling train at the sampling site. The leakage rate should not be in excess of 1 percent of the desired sampling rate. If condensation in the probe or filter is a problem, probe and filter heaters will be required. Adjust the heaters to provide a temperature at or above the stack temperature. However, membrane filters such as the Millipore AA are limited to about 225^{0} F. If the stack gas is in excess of about 200^{0} F, consideration should be given to an alternative procedure such as moving the filter holder downstream of the first impinger to insure that the filter does not exceed its temperature limit. Place crushed ice around the impingers. Add more ice during the test to keep the temperature of the gases leaving the last impinger at 70^{0} F. or less.

4.6 Beryllium train operation.

4.6.1 For each run, record the data required on the example sheet shown in Figure 104-6. Take readings at each sampling point at least every 5 minutes and when significant changes in stack conditions necessitate additional adjustments in flow rate.

4.6.2 Sample at a rate of 0.5 to 1.0 ft.^{3}/min. Samples shall be taken over such a period or periods as are necessary to accurately determine the maximum emissions which would occur in a 24-hour period. In the case of cyclic operations,

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PLANT _____

LOCATION _____

OPERATOR _____

DATE _____

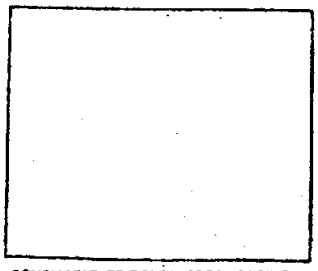
RUN NO. _____

SAMPLE BOX NO. _____

METER BOX NO. _____

METER $\Delta H_@$ _____

C FACTOR _____



SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE _____

BAROMETRIC PRESSURE _____

ASSUMED MOISTURE, % _____

HEATER BOX SETTING _____

PROBE LENGTH, m. _____

NOZZLE DIAMETER, in. _____

PROBE HEATER SETTING _____

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (P_S), in. Hg.	STACK TEMPERATURE (T_S), °F	VELOCITY HEAD (ΔP_S).	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH), in. H_2O	GAS SAMPLE VOLUME (Vm), ft^3	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
							INLET (Tm_{in}), °F	OUTLET (Tm_{out}), °F		
TOTAL							Avg.	Avg.		
AVERAGE							Avg.			

Figure 104-6. Field data

sufficient tests shall be made so as to allow accurate determination or calculation of the emissions which will occur over the duration of the cycle. A minimum sample time of 2 hours is recommended.

4.6.3 To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for at least 5 minutes at each, traverse point; sampling time must be the same for each point. Maintain isokinetic sampling throughout the sampling period. Nomographs which aid in the rapid adjustment of the sampling rate without other computations are in APTD-0576 and are available from commercial suppliers. Note that standard monographs are applicable only for Type S pitot tubes and air or a stack gas with an equivalent density. Contact ARB or the sampling train supplier for instructions when the standard nonograph is not applicable.

4.6.4 Turn off the pump at the conclusion of each run and record the final readings. Immediately remove the probe and nozzle from the stack and handle in accordance with the sample recovery process described in Section 4.7.

sufficient tests shall be made so as to allow accurate determination or calculation of the emissions which will occur over the duration of the cycle. A minimum sample time of 2 hours is recommended.

4.6.3 To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for at least 5 minutes at each, traverse point; sampling time must be the same for each point. Maintain isokinetic sampling throughout the sampling period. Nomographs which aid in the rapid adjustment of the sampling rate without other computations are in APTD-0576 and are available from commercial suppliers. Note that standard monographs are applicable only for Type S pitot tubes and air or a stack gas with an equivalent density. Contact ARB or the sampling train supplier for instructions when the standard nonograph is not applicable.

4.6.4 Turn off the pump at the conclusion of each run and record the final readings. Immediately remove the probe and nozzle from the stack and handle in accordance with the sample recovery process described in Section 4.7.

4.7 Sample Recovery.

4.7.1 (All glass storage bottles and the graduated cylinder must be precleaned as in 4.5.1.) This operation should be performed in an area free of possible beryllium contamination. When the sampling train is moved, care must be exercised to prevent breakage and contamination.

4.7.2 Disconnect the probe from the impinger train. Remove the filter and any loose particulate matter from the filter holder and place in a sample bottle. Place the contents (measured to ±1 ml) of the first three impingers into another sample bottle. Rinse the probe and all glassware between it and the back half of the third impinger with water and acetone, and add this to the latter sample bottle. Clean the probe with a brush or a long slender rod and cotton balls. Use acetone while cleaning. Add these to the sample bottle. Retain a sample of the water and acetone as a blank. The total amount of wash water and acetone used should be measured for accurate blank correction. Place the silica gel in the plastic jar. Seal and secure all sample containers for shipment. If an additional test is desired, the glassware can be carefully double rinsed with distilled water and reassembled. However, if the glassware is to be out of use more than 2 days, the initial acid wash procedure must be followed.

4.8 Analysis

4.8.1 Apparatus preparation. Clean all glassware according to the procedure of Section 4.5.1. Adjust the instrument settings according to the instrument manual, using an absorption wavelength of 234.8 nm.

4.8.2 Sample preparation. The digestion of beryllium samples is accomplished in part in concentrated perchloric acid. Caution: The analyst must insure that the sample is heated to light brown fumes after the initial nitric acid addition; otherwise, dangerous perchlorates may result from the subsequent perchloric acid digestion. Perchloric acid also should be used only under a perchloric acid hood.

4.8.2.1 Transfer the filter and any loose particulate matter from the sample container to a 150 ml beaker. Add 35 ml concentrated nitric acid. Heat on a hotplate until light brown fumes are evident to destroy all organic matter. Cool to room temperature and add 5 ml concentrated sulfuric acid and 5 ml concentrated perchloric acid. Then proceed with step 4.8.2.4

4.8.2.2 Place a portion of the water and acetone sample into a 150 ml beaker and put on a hotplate. Add portions of the remainder as evaporation proceeds and

4.8 Analysis

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4.8.2.1 Transfer the filter and any loose particulate matter from the sample container to a 150 ml beaker. Add 35 ml concentrated nitric acid. Heat on a hotplate until light brown fumes are evident to destroy all organic matter. Cool to room temperature and add 5 ml concentrated sulfuric acid and 5 ml concentrated perchloric acid. Then proceed with step 4.8.2.4

4.8.2.2 Place a portion of the water and acetone sample into a 150 ml beaker and put on a hotplate. Add portions of the remainder as evaporation proceeds and

evaporate to dryness. Cool the residue and add 35 ml concentrated nitric acid. Heat on a hotplate until light brown fumes are evident to destroy any organic matter. Cool to room temperature and add 5 ml concentrated sulfuric acid, and 5 ml concentrated perchloric acid. Then proceed with step 4.8.2.4.

4.8.2.3 Weigh the spent silica gel and report to the nearest gram.

4.8.2.4 Samples from 4.8.2.1 and 4.8.2.2 may be combined here for ease of analysis. Replace on a hotplate and evaporate to dryness in a perchloric acid hood. Cool and dissolve the residue in 10.0 ml of 25 percent V/V hydrochloric acid. Samples are now ready for the atomic absorption unit. The beryllium concentration of the sample must be within the calibration range of the unit. If necessary, further dilution of sample with 25 percent V/V hydrochloric acid must be performed to bring the sample within the calibration range.

4.8.3 Beryllium determination. Analyze the samples prepared in 4.8.2 at 234.8 nm using a nitrous oxide/acetylene flame. Aluminum, silicon and other elements can interfere with this

method if present in large quantities. Standard methods are available, however, to effectively eliminate these interferences (see Reference 5).

5. Calibration

5.1 Sampling Train.

5.1.1 Use standard methods and equipment as detailed in APTD-0576 to calibrate the rate meter, pitot tube, dry gas meter and probe heater (if used). Recalibrate prior to each test series.

5.2 Analysis

5.2.1 Standardization is made with the procedure as suggested by the manufacturer with standard beryllium solution. Standard solutions will be prepared from the stock solution by dilution with 25 percent V/V hydrochloric acid. The linearity of working range should be established with a series of standard solutions. If collected samples are out of the linear range, the samples should be diluted. Standards should be interspersed with the samples since the calibration can change slightly with time.

6. Calculations

6.1 Average dry gas meter temperature, stack temperature, stack pressure and average orifice pressure drop. See data sheet (Figure 104-6).

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6. Calculations

6.1 Average dry gas meter temperature, stack temperature, stack pressure and average orifice pressure drop. See data sheet (Figure 104-6).

6.2 Dry gas volume. Correct the sample volume measured by the dry gas meter to stack conditions by using equation 104-2.

$$V_{m_s} = V_m \frac{T_s}{T_m} \frac{P_{bar} + \frac{\Delta H}{13.6}}{P_s}$$

eq. 104-2

where:

V_{m_s} = Volume of gas sample through the dry gas meter (stack conditions). ft^3

V_m = Volume of gas sample through the dry gas meter (meter conditions). ft^3

T_s = Average temperature of stack gas, ^oR

T_m = Average dry gas meter temperature, ^oR

p_{bar} = Barometric pressure at the orifice meter, in Hg.

ΔH = Average pressure drop across the orifice meter, in H_2O.

13.6 = Specify gravity of mercury.

P_s = Stack pressure, $p_{bar} \pm$ static pressure, in Hg.

6.3 Volume of water vapor.

$$V_{w_s} = K_w V_{i_s} \frac{T_s}{P_s}$$

eq. 104-3

Where:

V_{w_s} = Volume of water vapor in the gas sample (stack conditions), ft^3.

K_w = $0.00267 \frac{in Hg\text{-}ft^3}{m/^oR}$, when these units are used

V_{i_s} = Total volume of liquid collected in impingers and silica gel (see Figure 104-7), ml.

T_s = Average stack gas temperature, ^oR

P_s = Stack pressure, P_{bar} ($\pm$ static pressure, in Hg.)

6.4 Total gas volume.

$$V_{total} = V_{m_s} + V_{w_s} \qquad \text{eq. 104-4}$$

Where:

V_{total} = Total volume of gas sample (stack condition), ft^3.

V_{m_s} = Volume of gas through dry gas meter (stack conditions), ft^3.

V_{w_s} = Volume of water vapor in gas sample (stack conditions), ft^3.

6.5 Stack gas velocity.

Use equation 104-5 to calculate the stack gas velocity.

$$(V_s)_{avg} = K_p C_p \left(\quad p\right)_{avg} \quad \frac{(T_s)_{avg}}{P_s M_s}$$

eq. 104-5

where:

$(V_s)avg$ = Average stack gas velocity, feet per second

K_p = $85.39 \frac{ft}{sec} \left(\frac{lb\text{-}inHg}{lb\ mole\text{-}^oR\text{-}inH_2O}\right)^{1/2}$, when these units are used.

C_p = Pitot tube coefficient, dimensionless.

(T_s) avg. = Average stack gas temperature, ^oR.

$(\quad p)$ avg. = Average square root of the velocity head of stack gas $(in\ H_2O)^{1/2}$ (see Figure 104-8).

P_s = Stack pressure, $P_{bar} \pm$ static pressure, in Hg.

T_s = Average stack gas temperature, ^oR

P_s = Stack pressure, P_{bar} ($\pm$ static pressure, in Hg.)

6.4 Total gas volume.

$$V_{total} = V_{m_s} + V_{w_s} \qquad \text{eq. 104-4}$$

Where:

V_{total} = Total volume of gas sample (stack condition), ft^3.

V_{m_s} = Volume of gas through dry gas meter (stack conditions), ft^3.

V_{w_s} = Volume of water vapor in gas sample (stack conditions), ft^3.

6.5 Stack gas velocity.

Use equation 104-5 to calculate the stack gas velocity.

$$(V_s)_{avg} = K_p C_p (\quad p)_{avg} \quad \frac{(T_s)_{avg}}{P_s M_s}$$

eq. 104-5

where:

$(V_s)avg$ = Average stack gas velocity, feet per second

K_p = $85.39 \frac{ft}{sec} \left(\frac{lb\text{-}inHg}{(lb\ mole\text{-}^oR\text{-}inH_2O)}\right)^{1/2}$, when these units are used.

C_p = Pitot tube coefficient, dimensionless.

(T_s) avg. = Average stack gas temperature, ^oR.

(p) avg. = Average square root of the velocity head of stack gas (in $H_2O)^{1/2}$ (see Figure 104-8).

P_s = Stack pressure, $P_{bar} \pm$ static pressure, in Hg.

M_s = Molecular weight of stack gas (wet basis), the summation of the products of the molecular weight of each component multiplied by its volumetric proportion in the mixture, lb/lb. mole.

Figure 104-8 shows a sample recording sheet for velocity traverse data. Use the averages in the last two columns of Figure 104-8 to determine the average stack gas velocity from equation 104-5.

6.6 Beryllium collected. Calculate the total weight of beryllium collected by using equation 104-6.

$$W_t = V_1C_1 - V_wC_w - V_aC_a$$

eq. 104-6

where:

W_t = Total weight of beryllium collected, ug.

V_t = Total volume of hydrochloric acid from step 4.8.2.4, ml.

C_t = Concentration of beryllium found in sample, ug/ml.

V_w = Total volume of water used in sampling (impinger contents plus all wash amounts), ml.

C_w = Blank concentration of beryllium in water, ug/ml.

PLANT_____

DATE_____

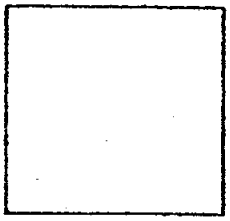
RUN NO._____

STACK DIAMETER, in._____

BAROMETRIC PRESSURE, in. Hg._____

STATIC PRESSURE IN STACK (P_g), in. Hg._____

OPERATORS_____



SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta_P}$	Stack Temperature (T_S), °F
AVERAGE:			

Figure 104-8. Velocity traverse data.

PLANT_____

DATE_____

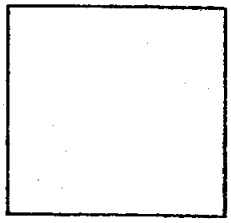
RUN NO._____

STACK DIAMETER, in._____

BAROMETRIC PRESSURE, in. Hg._____

STATIC PRESSURE IN STACK (P_g), in. Hg._____

OPERATORS_____



SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta_p}$	Stack Temperature (T_S), °F
AVERAGE:			

Figure 104-8. Velocity traverse data.

V_a = Total volume of acetone used in sampling (impinger contents plus all).

C_a = Blank concentration of beryllium in acetone, ug/ml.

6.7 Total beryllium emissions. Calculate the total amount of beryllium emitted from each stack per day by equation 104-7. This equation is applicable for continuous operations. For cyclic operations, use only the time per day each stack is in operation. The total beryllium emissions from a source will be the summation of results from all stacks.

$$R = W_t(V_s)_{avg} A_s/V_{total} \times 86{,}400 \text{ seconds/day}/10^6 \text{ ug/g}$$

eq. 104-7

where:

R = Rate of emission, g/day.

W_t = Total weight of beryllium collected, ug.

V_{total} = Total volume of gas sample (stack conditions), ft^3.

$(V_s)_{avg}$ = Average stack gas velocity, feet per second.

A_s = Stack area, ft^2.

6.8 Isokinetic variation (comparison of velocity of gas in probe tip to stack velocity).

$$I = 100\ V_{total}/A_n\theta/(VS)_{avg}$$

eq. 104-8

where:

I = Percent of isokinetic sampling.

V_{total} = Total volume of gas sample (stack conditions) ft^3.

A_n = Probe tip area, ft^2

θ = Sampling time, sec.

$(V_s)_{avg}$ = Average stack gas velocity, feet per second.

7. Evaluation of results.

7.1 Determination of compliance.

7.1.1 Each performance test shall consist of three repetitions of the applicable test method. For the purpose of determining compliance with an applicable national emission standard, the average of results of all repetitions shall apply.

7.2 Acceptable isokinetic results.

7.2.1 The following range sets the limit on acceptable isokinetic sampling results:

If 90 percent $\leq I \leq$ 110 percent, the results are acceptable; otherwise, reject the test and repeat.

where:

I = Percent of isokinetic sampling.

V_{total} = Total volume of gas sample (stack conditions) ft^3.

A_n = Probe tip area, ft^2

θ = Sampling time, sec.

$(V_s)_{avg}$ = Average stack gas velocity, feet per second.

7. Evaluation of results.

7.1 Determination of compliance.

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METHOD 106 - DETERMINATION OF VINYL CHLORIDE EMISSIONS FROM STATIONARY SOURCES

Introduction

Performance of this method should not be attempted by persons unfamilar with the operation of a gas chromatograph, nor by those who are unfamilar with source sampling, as there are many details that are beyond the scope of this presentation. Case must be exercised to prevent exposure of sampling personnel to vinyl chloride, a carcinogen.

1. Principle and Applicability

   1.1 An integrated bag sample of stack gas containing vinyl chloride (chloroethene) is subjected to chromatographic analysis, using a flame ionization detector.

   1.2 The method is applicable to the measurement of vinyl chloride in stack gases from ethylene dichloride, vinyl chloride and polyvinyl chloride manufacturing processes, except where the vinyl chloride is contained in particulate matter.

2. Range and Sensitivity. The lower limit of detection will vary according to the chromatograph used. Values reported include 1×10^{-7} mg and 4×10^{-7} mg.

3. Interferences. Acetaldehyde, which can occur in some vinyl chloride sources, will interfere with the vinyl chloride peak from the Chromasorb 102[1] column. See Sections 4.3.2 and 6.4. If resolution of the vinyl chloride peak is still not satisfactory for a particular sample, then

[1]Mention of trade names on specific products does not constitute endorsement by the Air Resources Board.

chromatograph parameters can be further altered with prior approval of the Executive Officer. If alteration of the chromatograph parameters fails to resolve the vinyl chloride peak, then supplemental confirmation of the vinyl chloride peak through an absolute analytical technique, such as mass spectroscopy, must be performed.

4. Apparatus

4.1 Sampling (Figure 106-1).

4.1.1 Probe. Stainless Steel, Pyrex glass, or Teflon Tubing according to stack temperature, each equipped with a glass wool plug to remove particulate matter.

4.1.2 Sample line. Teflon, 6.4 mim. outside diameter, of sufficient length at connect probe to bag. A new unused piece is employed for each series of bag samples that constitutes an emission test.

4.1.3 Male (2) and female (2) stainless steel quick-connects, with ball checks (one pair without) located as shown in Figure 106-1.

4.1.4 Tedlar bags, 100 liter capacity. To contain sample. Teflon bags are not acceptable. Aluminized Mylar bags may be used, provided that the samples are analyzed within 24 hours of collections.

4.1.5 Rigid leakproof containers for 4.1.4 with covering to protect contents from sunlight.

4.1.6 Needle valve. To adjust sample flow rate.

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4.1.5 Rigid leakproof containers for 4.1.4 with covering to protect contents from sunlight.

4.1.6 Needle valve. To adjust sample flow rate.

4.1.7 Pump. Leak-free. Minimum capacity 2 liters per minute.

4.1.8 Charcoal tube. To prevent admission of vinyl chloride to atmosphere in vicinity of samplers.

4.1.9 Flow meter. For observing sample flow rate: capable of measuring a flow range from 0.10 to 1.00 liter per minute.

4.1.10 Connecting tubing. Teflon, 6.4 mm outside diameter to assembly sample train (Figure 106-1).

4.1.11 Pitot tube. Type S (or equivalent), attached to the probe so that the sampling flow rate can be regulated proportional to the stack gas velocity.

4.2 Sample Recovery.

4.2.1 Tubing. Teflon, 6.4 mm outside diameter, to connect bag to gas chromatograph sample loop. A new unused piece is employed for each series of bag samples that constitutes an emission test and is to be discarded upon conclusion of analysis of those bags.

4.3 Analysis

4.3.1 Gas chromatograph. With flame ionization detector, potentiometric strip chart recorder and 1.0 to 5.0 ml heated sampling loop in automatic sample valve.

4.3.2 Chromatographic column. Stainless steel, 2 m x 3.2 mm, containing 80/100 mesh Chromasorb 102. A secondary column of GE SF-96, 20 percent on 60/80 mesh AW Chromasorb P, stainless steel, 2 m x 3.2 mm or Porapak T, 80/100 mesh, stainless steel, 1 m x 3.2 mm is required if

4.1.7 Pump. Leak-free. Minimum capacity 2 liters per minute.

4.1.8 Charcoal tube. To prevent admission of vinyl chloride to atmosphere in vicinity of samplers.

4.1.9 Flow meter. For observing sample flow rate: capable of measuring a flow range from 0.10 to 1.00 liter per minute.

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acetaldehyde is present. If used, a secondary column is placed after the Chromasorb 102 column. The combined columns should then be operated at 120° C.

4.3.3 Flow meters (2). Rotameter type, 0 to 100 ml/min capacity, with flow control valves.

4.3.4 Gas regulators. For required gas cylinders.

4.3.5 Thermometer. Accurate to one degree centigrade, to measure temperature of heated sample loop at time of sample injection.

4.3.6 Barometer. Accurate to 5 mm Hg. to measure atmospheric pressure around gas chromatograph during sample analysis.

4.3.7 Pump. Leak-free. Minimum capacity 100 ml/min.

4.4 Calibration

4.4.1 Tubing. Teflon, 6.4 mm outside diameter, separate pieces marked for each calibration concentration.

4.4.2 Tedlar bags. Sixteen-inch square size, separate bag marked for each calibration concentration.

4.4.3 Syringe. 0.5 ml, gas tight

4.4.4 Syringe. 50 ml , gas tight.

4.4.5 Flow meter. Rotameter type, 0 to 1000 ml/min range accurate to $\pm$ 1%, to meter nitrogen in preparation of standard gas mixtures.

4.4.6 Stop watch. Of known accuracy, to time gas flow in preparation of standard gas mixtures.

5. Reagents. It is necessary that all reagents be of chromatographic grade.

5.1 Analysis.

5.1.1 Helium gas or nitrogen gas. Zero grade, for chromatographic carrier gas.

5.1.2 Hydrogen gas. Zero grade.

5.1.3 Oxygen gas, or Air, as required by the detector. Zero grade.

5.2 Calibration. Use one of the following options: either 5.2.1 and 5.2.2, or 5.2.3.

5.2.1 Vinyl chloride, 99.9+ percent. Pure vinyl chloride gas certified by the manufacturer to contain a minimum of 99.9 percent vinyl chloride for use in the preparation of standard gas mixtures in Section 7.1. If the gas manufacturer maintains a bulk cylinder supply of 99.9+ percent vinyl chloride, the certification analysts may have been performed on this supply rather than on each gas cylinder prepared from this bulk supply. The date of gas cylinder preparation and the certified analysis must have been affixed to the cylinder before shipment from the gas manufacturer to the buyer.

5.2.2 Nitrogen gas. Zero grade, for preparation of standard gas mixtures.

5. Reagents. It is necessary that all reagents be of chromatographic grade.

5.1 Analysis.

5.1.1 Helium gas or nitrogen gas. Zero grade, for chromatographic carrier gas.

5.1.2 Hydrogen gas. Zero grade.

5.1.3 Oxygen gas, or Air, as required by the detector. Zero grade.

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5.2.2 Nitrogen gas. Zero grade, for preparation of standard gas mixtures.

5.2.3 Cylinder standards (3). Gas mixture standards (50, 10, and 5 ppm vinyl chloride in nitrogen cylinders) for which the gas composition has been certified by the manufacturer. The manufacturer must have recommended a maximum shelf life for each cylinder so that te concentration does not change greater than ±5 percent from the certified value. The date of gas cylinder preparation, certified vinyl chloride concentration and recommended maximum shelf life must have been affixed to the cylinder before shipment from the gas manufacturer to the buyer. These gas mixture standards may be directly used to prepare a chromatograph calibration curve as described in Section 7.3.

5.2.3.1 Cylinder standards certification. The concentration of vinyl chloride in nitrogen in each cylinder must have been certified by the manufacturer by a direct analysis of each cylinder using an analytical procedure that the manufacturer had calibrated on the day of cylinder analysis. The calibration of the analytical procedure shall, as a minimum, have utilized a three-point calibration curve. It is recommended that the manufacturer maintain two calibration standards and use these standards in the following way: (1) A high concentration standard (between 50 and 100 ppm) for preparation of a calibration curve by an appropriate dilution technique; (2) a low concentration standard (between 5 and 10 ppm) for verification of the dilution technique used.

5.2.3.2 Establishment and verification of calibration standards. The concentration of each calibration standard must have been established by the manufacturer using reliable procedures. Additionally, each calibration standard must have been verified by the manufacturer by one of the following procedures, and the agreement between the initially determined concentration value and the verification concentration value must be within ±5 percent: (1) verification value determined by comparison with a calibrated vinyl chloride permeation tube, (2) verification value determined by comparison with a gas mixture prepared in accordance with the procedure described in Section 7.1 and using 99.9+ percent vinyl chloride, or (3) verification value obtained by having the calibration standard analyzed by the National Bureau of Standards. All calibration standards must be renewed on a time interval consistent with the shelf life of the cylinder standards sold.

6. Sampling.

6.1 Procedure. Assemble the sample train as in Figure 106-1. Perform a bag leak check according to Section 7.4. Observe that all connections between the bag and the probe are tight. Place the end of the probe at the centroid of the stack and start the pump with the needle valve

5.2.3.2 Establishment and verification of calibration standards. The concentration of each calibration standard must have been established by the manufacturer using reliable procedures. Additionally, each calibration standard must have been verified by the manufacturer by one of the following procedures, and the agreement between the initially determined concentration value and the verification concentration value must be within ±5 percent: (1) verification value determined by comparison with a calibrated vinyl chloride permeation tube, (2) verification value determined by comparison with a gas mixture prepared in accordance with the procedure described in Section 7.1 and using 99.9+ percent vinyl chloride, or (3) verification value obtained by having the calibration standard analyzed by the National Bureau of Standards. All calibration standards must be renewed on a time interval consistent with the shelf life of the cylinder standards sold.

6. Sampling.

6.1 Procedure. Assemble the sample train as in Figure 106-1. Perform a bag leak check according to Section 7.4. Observe that all connections between the bag and the probe are tight. Place the end of the probe at the centroid of the stack and start the pump with the needle valve

adjusted to yield a flow of 0.5 lpm. After a period of time sufficient to purge the line several times has elapsed, connect the vacuum line to the bag and evacuate the bag until the rotameter indicates no flow. then reposition the sample and vacuum lines and begin the actual sampling, keeping the rate proportional to the stack velocity. Direct the gas exiting the rotameter away from sampling personnel. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the vacuum line from the bag container. Protect the bag container from sunlight.

6.2 Sample storage. Sample bags must be kept out of direct sunlight. When at all possible analysis is to be performed within 24 hours, but in no case in excess of 72 hours of sample collection.

6.3 Sample recovery. With a piece of Teflon tubing identified for that bag, connect a bag inlet valve to the gas chromatograph sample valve. Switch the valve to withdraw gas from the bag through the sample loop. Plumb the equipment so the sample gas passes from the sample valve to the leak-free pump, and then to a charcoal tube, followed by a 0-100 ml/min rotameter with flow control valve.

6.4 Analysis. Set the column temperature to 100° C, the detector temperature to 150° C, and the sample loop temperature to 70° C. When optimum hydrogen and oxygen flow rates have been determined verify and maintain these flow rates during all chromatograph operations. Using zero helium or nitrogen as the carrier gas, establish a flow rate in the range consistent with the manufacturer's requirements for satisfactory detector operation. A flow rate of

approximately 40 ml/min should produce adequate separations. Observe the base line periodically and determine that the noise level has stabilized and that base line drift has ceased. Purge the sample loop for thirty seconds at the rate of 100 ml/min, then activate the sample valve. Record the injection time (the position of the pen on the chart at the time of sample injection), the sample number, the sample loop temperature, the column temperature, carrier gas flow rate, chart speed and the attenuator setting. Record the laboratory pressure. From the chart, select the peak having the retention time corresponding to vinyl chloride, as determined in Section 7.2. Measure the peak area, Am, by use of a disc integrator or a planimeter. Measure the peak height, Hm. Record Am, Hm and the retention time. Repeat the injection at least two times or until two consecutive vinyl chloride peaks do not vary in area more than 5%. The average value for these two areas will be used to compute the bag concentration.

Compare the ratio of Hm to Am for the vinyl chloride sample with the same ratio for the standard peak which is closest in height. As a guideline, if these ratios differ by more than 10%, the vinyl chloride peak may not be pure (possibly acetaldehyde is present) and the secondary column should be employed (see Section 4.3.2)

6.5 Measure the ambient temperature and barometric pressure near the bag. (Assume the relative humidity to be 100 percent.) From a water saturation vapor pressure table, determine and record the water vapor content of the bag.

approximately 40 ml/min should produce adequate separations. Observe the base line periodically and determine that the noise level has stabilized and that base line drift has ceased. Purge the sample loop for thirty seconds at the rate of 100 ml/min, then activate the sample valve. Record the injection time (the position of the pen on the chart at the time of sample injection), the sample number, the sample loop temperature, the column temperature, carrier gas flow rate, chart speed and the attenuator setting. Record the laboratory pressure. From the chart, select the peak having the retention time corresponding to vinyl chloride, as determined in Section 7.2. Measure the peak area, Am, by use of a disc integrator or a planimeter. Measure the peak height, Hm. Record Am, Hm and the retention time. Repeat the injection at least two times or until two consecutive vinyl chloride peaks do not vary in area more than 5%. The average value for these two areas will be used to compute the bag concentration.

Compare the ratio of Hm to Am for the vinyl chloride sample with the same ratio for the standard peak which is closest in height. As a guideline, if these ratios differ by more than 10%, the vinyl chloride peak may not be pure (possibly acetaldehyde is present) and the secondary column should be employed (see Section 4.3.2)

6.5 Measure the ambient temperature and barometric pressure near the bag. (Assume the relative humidity to be 100 percent.) From a water saturation vapor pressure table, determine and record the water vapor content of the bag.

7. Calibration and Standards.

7.1 Preparation of vinyl chloride standard gas mixtures. Evacuate a sixteen-inch square Tedlar bag that has passed a leak check (described in Section 7.4) and meter in 5 liters of nitrogen. While the bag is filling, use the 0.5 ml syringe to inject 250 ml of 99.9+ percent vinyl chloride through the wall of the bag. Upon withdrawing the syringe needle immediately cover the resulting hole with a piece of adhesive tape. The bag now contains a vinyl chloride concentration of 50 ppm. In a like manner use the other syringe to prepare gas mixtures having 10 and 5 ppm vinyl chloride concentrations. Place each bag on a smooth surface and alternately depress opposite sides of the bag 50 times to further mix the gases. These gas mixture standards may be used for 10 days from the date of preparation, after which time preparation of new gas mixtures is required. (CAUTION. Contamination may be a problem when a bag is reused if the new gas mixture standard contains a lower concentration than the previous gas mixture standard did.)

7.2 Determination of vinyl chloride retention time. This section can be performed simultaneously with Section 7.3. Establish chromatograph conditions identical with those in Section 6.3, above. Set attenuator to X 1 position. Flush the sampling loop with zero helium or nitrogen and activate the sample valve. Record the injection time, the sample loop temperature, the column temperature, the carrier gas flow rate, the chart speed and the attenuator setting. Record peaks and detector responses that occur in the absence of vinyl chloride. Maintain conditions. With the equipment plumbing

arranged identically to Section 6.3, flush the sample loop for 30 seconds at the rate of 100 ml/min with one of the vinyl chloride calibration mixtures and activate the sample valve. Record the injection time. Select the peak that corresponds to vinyl chloride. Measure the distance on the chart from the injection time to the time at which the peak maximum occurs. This quantity, divided by the chart speed, is defined as the retention time record.

7.3 Preparation of chromatograph calibration curve. Make a gas mixture standard (described in Section 5.2.2 or 7.1) using conditions identical with those listed in Sections 6.3 and 6.4. Flush the sampling loop for 30 seconds at the rate of 100 ml/min with each standard gas mixture and activate the sample valve. Record Cc, the concentration of vinyl chloride injected, the attenuator setting, chart speed, peak area, sample loop temperature, column temperature, carrier gas flow rate, and retention time. Record the laboratory pressure. Calculate Ac, the peak area multiplied by the attenuator setting. Repeat until two injection areas are within 5 percent, then plot these points v. Cc. When the other concentrations have been plotted, draw a smooth curve through the points. Perform calibration daily, or before and after each set of bag samples, whichever is more frequent.

7.4 Bag leak checks. While performance of this section is required subsequent to bag use, it is also advised that it be performed prior to bag use. After each use, make sure a bag did not develop leaks as follows. To leak check, connect a water manometer and pressurize the bag to 5-10cm H_2O (2-4 in H_2O). Allow to stand for 10 minutes.

arranged identically to Section 6.3, flush the sample loop for 30 seconds at the rate of 100 ml/min with one of the vinyl chloride calibration mixtures and activate the sample valve. Record the injection time. Select the peak that corresponds to vinyl chloride. Measure the distance on the chart from the injection time to the time at which the peak maximum occurs. This quantity, divided by the chart speed, is defined as the retention time record.

7.3 Preparation of chromatograph calibration curve. Make a gas mixture standard (described in Section 5.2.2 or 7.1) using conditions identical with those listed in Sections 6.3 and 6.4. Flush the sampling loop for 30 seconds at the rate of 100 ml/min with each standard gas mixture and activate the sample valve. Record Cc, the concentration of vinyl chloride injected, the attenuator setting, chart speed, peak area, sample loop temperature, column temperature, carrier gas flow rate, and retention time. Record the laboratory pressure. Calculate Ac, the peak area multiplied by the attenuator setting. Repeat until two injection areas are within 5 percent, then plot these points v. Cc. When the other concentrations have been plotted, draw a smooth curve through the points. Perform calibration daily, or before and after each set of bag samples, whichever is more frequent.

7.4 Bag leak checks. While performance of this section is required subsequent to bag use, it is also advised that it be performed prior to bag use. After each use, make sure a bag did not develop leaks as follows. To leak check, connect a water manometer and pressurize the bag to 5-10cm H_2O (2-4 in H_2O). Allow to stand for 10 minutes.

Any displacement in the water manometer indicates a leak. Also check the rigid container for leaks in this manner.

NOTE: An alternative leak check method is to pressurize the bag to 5-10 cm H_2O or 2-4 in. H_2O and allow to stand overnight. A deflated bag indicates a leak.) For each sample bag in its rigid container, place a rotameter in-line between the bag and the pump inlet. Evacuate the bag. Failure of the rotameter to register zero flow when the bag appears to be empty indicates a leak.)

8. Calculations.

8.1 Determine the sample peak area as follows:

$$A_c = A_m A_f \qquad \text{Equation 106-1.}$$

Where:

A_c = The sample peak area.

A_m = The measured peak area.

A_f = The attenuation factor.

8.2 Vinyl chloride concentrations. From the calibration curve described in Section 7.3, above, select the value of C_c that corresponds to A_c, the sample peak area. Calculate C_b as follows:

$$C_b = \frac{C_c P_r T_i}{P_i T_r (1-B_{wb})} \qquad \text{Equation 106-2}$$

Where:

B_{wb} = The water vapor content of the bag sample, as analyzed.

C_b = The concentration of vinyl chloride in the bag sample in ppm.

C_c = The concentration of vinyl chloride indicated by the gas chromatograph, in ppm.

P_r = The reference pressure, the laboratory pressure recorded during calibration, mm Hg.

T_i = The sample loop temperature on the absolute scale at the time of analysis, ^oK.

P_i = The laboratory pressure at time of analysis, mm Hg.

T_r = The reference temperature, the sample loop temperature recorded during calibration, ^oK.

9. References

1. Brown, D. W., Loy, E. W. and Stephenson, M. H. "Vinyl Chloride Monitoring Near the B. F. Goodrich Chemical Company in Louisville, Kentucky." Region IV, U. S. Environmental Protection Agency, Surveillance and Analysis Division, Athens, George, June 24, 1974.

2. "Evaluation of a Collection and Analytical Procedure for Vinyl Chloride in Air," by G. D. Clayton and Associates, December 13, 1974. EPA Contract No. 68-02-1408, Task Order No. 2, EPA Report No. 75-VCL-1.

3. "Standardization of Stationary Source Emission Method for Vinyl Chloride," by Midwest Research Institute, 1976. EPA Contract 68-02-1098. Task Order No. 7.

C_c = The concentration of vinyl chloride indicated by the gas chromatograph, in ppm.

P_r = The reference pressure, the laboratory pressure recorded during calibration, mm Hg.

T_i = The sample loop temperature on the absolute scale at the time of analysis, ^oK.

P_i = The laboratory pressure at time of analysis, mm Hg.

T_r = The reference temperature, the sample loop temperature recorded during calibration, ^oK.

9. References

1. Brown, D. W., Loy, E. W. and Stephenson, M. H. "Vinyl Chloride Monitoring Near the B. F. Goodrich Chemical Company in Louisville, Kentucky." Region IV, U. S. Environmental Protection Agency, Surveillance and Analysis Division, Athens, George, June 24, 1974.

2. "Evaluation of a Collection and Analytical Procedure for Vinyl Chloride in Air," by G. D. Clayton and Associates, December 13, 1974. EPA Contract No. 68-02-1408, Task Order No. 2, EPA Report No. 75-VCL-1.

3. "Standardization of Stationary Source Emission Method for Vinyl Chloride," by Midwest Research Institute, 1976. EPA Contract 68-02-1098. Task Order No. 7.

Adopt Article 2, Subchapter 8, Chapter 1, Part III, Title 17, California Administrative Code, Sections 94100-94116, to read as follows:

Article 2. Test Methods for Determining Compliance with District Nonvehicular Emission Standards

94100. Applicability

The test methods set forth in this article shall be used to determine compliance with the nonvehicular emission standards of the districts. However, where a district board, air pollution control officer or executive officer has established a test method concerning the same subject as a test method set forth in this article, the district test method shall be used to determine compliance with the district's nonvehicular emission standards.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94101. Method 1 - Sample and Velocity Traverses.

The test procedure for determining traverse points for sample and velocity measurements is set forth in the Air Resources Board's Method 1, Sample and Velocity Traverses for Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94102. Method 2 - Velocity and Volumetric Flow Rate.

The test method for determining stack gas velocity and volumetric flow rate using a type S pitot tube is set forth in the Air Resources Board's Method 2, Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube), adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94103. Method 3 - Gas Analysis.

The test method for determining carbon dioxide, oxygen, excess air and molecular weight on a dry basis in stack gases is set forth in the Air Resources Board's Method 3, Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94104. Method 4 - Moisture Content.

The test method for determining the moisture content in stack gases is set forth in the Air Resources Board's Method 4, Determination of Moisture Content in Stack Gases, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94105. Method 5 - Particulate Matter Emissions.

The test method for determining particulate matter emissions is set forth in the Air Resources Board's Method 5, Determination of Particulate Matter Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94106. Method 6 - Sulfur Dioxide.

The test method for determining sulfur dioxide emissions is set forth in the Air Resources Board's Method 6, Determination of Sulfur Dioxide Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94107. Method 7 - Nitrogen Oxides.

The test method for determining nitrogen oxide emissions is set forth in the Air Resources Board's Method 7, Determination of Nitrogen Oxide Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94108. Method 8 - Sulfuric Acid Mist and Sulfur Dioxide.

The test method for determining sulfuric acid mist and sulfur dioxide emissions is set forth in the Air Resources Board's Method 8, Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94109. Method 10 - Carbon Monoxide.

The test method for determining carbon monoxide emissions is set forth in the Air Resources Board's Method 10, Determination of Carbon Monoxide Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94110. Method 11 - Hydrogen Sulfide.

The test method for determining the hydrogen sulfide content in petroleum refinery fuel gas streams is set forth in the Air Resources Board's Method 11, Determination of Hydrogen Sulfide Content of Fuel Gas Streams in Petroleum Refineries, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94111. Method 15 - Sulfides.

The test method for determining hydrogen sulfide, carbonyl sulfide, and carbon disulfide emissions is set forth in the Air Resources Board's Method 15, Determination of Hydrogen Sulfide, Carbonyl Sulfide, and Carbon Disulfide Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94112. Method 16 - Sulfur.

The test method for determining emissions of total reduced sulfur is set forth in the Air Resources Board's Method 16, Semicontinuous Determination of Sulfur Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94113. Method 17 - Particulate Matter Emissions (In-Stack).

The test method for determining particulate matter emissions using an in-stack filtration method is set forth in the Air Resources Board's Method 17, Determination of Particulate Matter Emissions from Stationary Sources (In-stack Filtration Method), adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94114. Method 100 - Continuous Sampling.

The test method for continuous gaseous emission stack sampling is set forth in the Air Resources Board's Method 100, Procedures for Continuous Gaseous Emission Stack Sampling, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94115. Method 104 - Beryllium.

The test method for determining particulate beryllium emissions is set forth in the Air Resources Board's Method 104, Determination of Beryllium Emissions from Stationary Sources, adopted June 29, 1983

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

94116. Method 106 - Vinyl Chloride.

The test method for determining vinyl chloride emissions from ethylene dichloride, vinyl chloride and polyvinyl chloride manufacturing processes is set forth in the Air Resources Board's Method 106, Determination of Vinyl Chloride Emissions from Stationary Sources, adopted June 29, 1983.

NOTE: Authority cited: Sections 39600, 39601, and 39607, Health and Safety Code. Reference: Sections 39515, 39516, 39605, 39607, and 40001, Health and Safety Code.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Adoption of Title 17, California Administrative Code, Sections 94100-94116, Regarding Test Methods for Determining Compliance with District Nonvehicular (Stationary Source) Emission Standards

Agenda Item No.: 83-8-1

Public Hearing Date: June 29, 1983

Response Date: June 29, 1983

Issuing Authority: Air Resources Board

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no adverse environmental effects.

Response: N/A

CERTIFIED: _____
Board Secretary

DATE: August 26, 1983

RECEIVED BY
Office of the Secretary

DEC 0 6 1983

Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject: Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS

83-15
83-16
83-21
83-22
83-24

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution 83-15

June 30, 1983

Agenda Item No.: 83-8-3

WHEREAS, the Air Resources Board (the "Board") is authorized, pursuant to the authority set forth in Health and Safety Code Sections 39600, 39601, and 41704.5 to adopt regulations relating to the control of visible emissions from marine vessels;

WHEREAS, Health and Safety Code Section 41701 prohibits the discharge into the atmosphere of any air contaminant, other than uncombined water vapor, for a period or periods aggregating more than three minutes in any one hour which is as dark or darker in shade as that designated as No. 2 on the Ringelmann Chart, or of an opacity equal to or greater than 40 percent;

WHEREAS, Health and Safety Code Section 41704(j) exempts from the standard specified in Section 41701 emissions from vessels with steam boilers during emergency boiler shutdowns for safety reasons, safety and operational tests required by governmental agencies, and where maneuvering is required to avoid hazards;

WHEREAS, Health and Safety Code Section 41704(k) relaxes the standard specified in Section 41701 until January 1, 1984, for marine vessels with steam boilers during cold boiler light-off operations and while drying wet or green refractory to the extent that such emissions are not as dark or darker in shade as that designated as No. 2 on the Ringelmann Chart, or of an opacity equal to or greater than 40 percent for a period or periods aggregating more than 15 minutes in any one hour;

WHEREAS, Health and Safety Code Section 41704.5 requires the Board to conduct a study to determine whether vessels with steam boilers can be brought into compliance with Section 41701 by January 1, 1984 or earlier, and following completion of such study, to conduct a public hearing to consider and if appropriate, adopt a compliance schedule by which various classes of vessels will be brought into compliance with the standard specified in Section 41701 on and after January 1, 1984;

WHEREAS, the Board has conducted the study in accordance with Section 41704.5 of the Health and Safety Code, approved the report on the results of the study on December 8, 1982, and submitted the report to the Legislature on December 29, 1982;

WHEREAS, the report indicates that the permanent exemption set forth in Section 41704(j) is warranted, but that the relaxation set forth in Section 41704(k) is not warranted beyond January 1, 1984 except as it pertains to certain U.S. Navy vessels that cannot at present be operated in compliance with the standard and that all other vessels can comply with the standard by January 1, 1984;

WHEREAS, the California Environmental Quality Act (CEQA) and Air Resources Board regulations require that an activity not be approved as proposed if there are feasible alternatives or mitigation measures which would significantly reduce any adverse environmental impacts identified;

WHEREAS, the Board has held a duly-noticed public hearing on June 30, 1983, to consider adoption of a compliance schedule for the U.S. Navy vessels which require more time to comply;

WHEREAS, the Board recognizes the need to reduce visible emissions from marine vessels in a cost-effective fashion that will minimize economic hardship and safety hazards;

WHEREAS, the Board recognizes that some air pollution control and air quality management districts have difficult air quality problems that may require the adoption of regulations that are more stringent than state law;

WHEREAS, the Board finds that:

certain U.S. Navy vessels require ship modifications or additional dockside steam to enable them to be operated in compliance with the Section 41701 visible emission standard;

the compliance schedule proposed by staff for those U.S. Navy vessels that cannot at present be operated in compliance with Section 41701 allows the Navy sufficient time to make the necessary ship modifications and to provide additional dockside steam;

all U.S. Navy vessels should be able to comply with the visible emission standard in Health and Safety Code Section 41701 by January 1, 1986; and

no adverse environmental impacts have been identified with regard to adoption by the Board of a compliance schedule for the specified U.S. Navy vessels;

NOW, THEREFORE, BE IT RESOLVED that the Board approves Subchapter 2.5, Section 85000, for inclusion into Title 17, California Administrative Code, as set forth in Attachment A hereto and directs the Executive Officer to adopt the compliance schedule after making it available to the public for 15 days.

BE IT FURTHER RESOLVED that the Board recognizes and supports the authority of air pollution control and air quality management districts to adopt regulations that are more stringent that state law.

I certify that this a true and correct copy of Resolution 83-15 as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

ATTACHMENT A

PROPOSED ADDITION TO TITLE 17, CALIFORNIA ADMINISTRATIVE CODE

Add Subchapter 2.5, Section 85000 of Title 17, California Administrative Code, to read as follows:

Subchapter 2.5. Compliance Schedule Regarding Visible Emissions from Specified Vessels

85000. Compliance Schedule for United States Navy Vessels.

(a) During the period from January 1, 1984 to January 1, 1986, the visible emission standard set forth in Section 41701 of the Health and Safety Code shall be extended from a period or periods aggregating three minutes in any one hour to a period or periods aggregating fifteen minutes in any one hour for emissions, during the cold light-off of one boiler per vessel, from United States Navy vessels in Navy classes AVT-16, CG-16, CG-26, CV-41, CV-63, CV-60, CV-59, DD-710, ~~DD-931,~~ ~~DD-933,~~ DD-945, ~~DD-948,~~ DDG-2, ~~DDG-31,~~ DDG-37, LSD-28, BB-61, and CV-64.

(b) During the period from January 1, 1984, to January 1, 1985, the visible emission standard set forth in Section 41701 of the Health and Safety Code shall be extended from a period or periods aggregating three minutes in any one hour to a period or periods aggregating nine minutes in any one hour for emission, during the cold light-off of one boiler per vessel, from United States Navy vessels in Navy classes FFG-1, AD-14, ~~DD-743,~~ FF-1040, ~~DD-784,~~ DD-825, ~~DD-876,~~ DD-886, AR-6, AO-146, AVM-1, AE-21, and AE-24.

(c) During the period from January 1, 1985 to January 1, 1986, the visible emission standard set forth in Section 41701 of the Health and Safety Code shall be extended from a period or periods aggregating three minutes in any one hour to a period or periods aggregating six minutes in any one hour for emissions, during the cold light-off of one boiler per vessel, from United States Navy vessels in Navy classes FFG-1, AD-14, DD-743, FF-1040, DD-784, DD-825, DD-876, DD-886, AR-6, AO-146, AVM-1, AE-21, and AE-24, only if sufficient steam at the required pressure is not available at dockside to enable light-off in compliance with the visible emission standard set forth in Section 41701.

NOTE: Authority cited: Sections 39600, 39601, and 41704.5, Health and Safety Code. Reference: Sections 41701, 41704(j), 41704(k), and 41704.5, Health and Safety Code.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Adoption of Subchapter 2.5, Section 85000 into Title 17, California Administrative Code, Regarding Visible Emissions from Certain United States Navy Steam Vessels

Agenda Item No.: 83-8-3

Public Hearing Date: June 29, 1983

Response Date: August 4, 1983

Issuing Authority: Executive Officer

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no adverse environmental impacts, although it provides a compliance schedule that continues relaxation of the state visible emission standard during cold boiler light-off for certain United States Navy vessel classes for a limited time.

Response: Because certain Navy vessels are unable to meet the standard of no more than three minutes of excess visible emissions in any one hour until January 1, 1986, enforcement of the three-minute standard between January 1, 1984, and January 1, 1986, would likely result in the issuance of notices of violation by air pollution control district personnel, but not in reduced emissions.

CERTIFIED: _____
Executive Officer

Date: 1/27/84

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject : Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
83-14
[redacted]
83-16
83-21
83-22
83-24

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution 83-16

June 30, 1983

Agenda Item No.: 83-9-1

WHEREAS, Sections 39600 and 39601 of the Health and Safety Code authorize the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Sections 39002, 43000, 43013, 43101, and 43104 of the Health and Safety Code authorize the Board to adopt emission standards and test procedures to control air pollution caused by motor vehicles;

WHEREAS, Section 43100 of the Health and Safety Code authorizes the Board to certify new motor vehicles, and Section 43102 provides that no new motor vehicle shall be certified unless it meets the emission standards and test procedures adopted by the Board;

WHEREAS, Section 43106 of the Health and Safety Code requires that each new motor vehicle required to meet the emission standards established pursuant to Section 43101 be, in all material respects, substantially the same in construction as the test motor vehicle certified by the Board;

WHEREAS, Section 43204 of the Health and Safety Code requires the manufacturer of each motor vehicle and motor vehicle engine to warrant to the ultimate purchaser and each subsequent purchaser that the motor vehicle or engine is:

(1) Designed, built, and equipped so as to conform, at the time of sale, with the applicable emission standards;

(2) Free from defects in materials and workmanship which cause such motor vehicle or motor vehicle engine to fail to conform with the applicable regulations for its useful life;

WHEREAS, the certification procedures adopted by the Board require a demonstration that the vehicle complies with the applicable emission standards throughout the useful life of the motor vehicle;

WHEREAS, the Board has adopted emission control system warranty regulations which are set forth in Title 13, California Administrative Code, Sections 2035 et seq., including the Emissions Warranty Parts List, dated December 14, 1978;

WHEREAS, the Legislature has recently amended Health and Safety Code Section 43204 (Stats 1982, Ch. 1173; AB 2046) to reduce the warranty coverage required on specific emissions-related components for those new vehicles certified to the optional emission standards pursuant to Section 1960.15, Title 13, California Administrative Code, and first sold on or after January 1, 1983;

WHEREAS, in 1982 the Legislature authorized (Stats 1982, Ch. 892) the implementation of a biennial motor vehicle inspection and maintenance program in the major urban nonattainment areas of the state which is scheduled to commence operations in March 1984;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project having potential significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available to reduce and avoid such impacts;

WHEREAS, the staff has proposed regulatory amendments reflecting the provisions of AB 2046 and has prepared a staff report evaluating the proposed amendments and indicating that except for the amendment reducing the warranty coverage on vehicles certified to California optional standards, these amendments would not be expected to result in any significant potential adverse environmental impacts;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code; and

WHEREAS, the Board finds that:

The emission control system warranty regulations have been effective in reducing in-use defects in emissions-related parts and encouraging repair when emissions-related parts fail;

It is necessary and appropriate to amend these warranty regulations to reflect the reduced warranty coverage provided by Health and Safety Code Section 43204, as amended in 1982, for vehicles certified to the Board's optional standards;

It is necessary and appropriate to amend Section 2039 of these warranty regulations to address the revised motor vehicle inspection program authorized by the Legislature in 1982;

It is necessary and appropriate to add to the Emissions Warranty Parts List certain parts whose failure is likely to impair substantially the ability of a vehicle's emissions control system to reduce exhaust emissions as required, as demonstrated during the Board's administration of the existing regulations;

A potentially significant adverse environmental effect may result from this action in that there may be increased emissions from motor vehicles, although any such increases from the failure of emission control system components will be limited to the extent that they are detected and repaired as a result of the motor vehicle inspection program authorized in 1982 for California's major urban nonattainment areas.

There are no feasible alternatives or mitigation measures available to reduce any potential adverse air quality impacts from the amendment reducing warranty coverage consistent with Health and Safety Code Section 43204, and in all other respects the adoption of the proposed amendments will not result in potential adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby adopts amendments to Title 13, California Administrative Code, Sections 2035, 2036(c), 2039, and the Emissions Warranty Parts List referenced in Section 2036(c), as set forth in Attachments I and II.

BE IT FURTHER RESOLVED that the added parts adopted herein for the warranted parts list referenced in Section 2036(c) shall not be required for the manufacturers' statements submitted under Section 2036 before the 1985 model year.

BE IT FURTHER RESOLVED that the Board hereby determines that the regulatory amendments adopted herein do not render California regulations less protective of public health and welfare than the comparable federal standards or inconsistent with Section 202(a) of the Clean Air Act.

BE IT FURTHER RESOLVED that each part of the regulations amended herein shall be deemed severable, and, in the event that any part of these regulations is held to be invalid, the remainder of the regulations shall continue in full force and effect.

I certify that this a true and correct copy of Resolution 83-16 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

ATTACHMENT I

PROPOSED AMENDMENTS
TO TITLE 13, CALIFORNIA ADMINISTRATIVE CODE, SECTIONS 2035 AND 3039

Amend Section 2035(c)(1) by adding a new subsection (F), and renumbering the remaining subsection to read as follows:

(F) In the case of vehicles certified to the optional emission standards pursuant to Health and Safety Code Section 43101.5(a), which are sold on or after January 1, 1983, for fuel metering and ignition components contained in the state board's "Emissions Warranty Parts List", dated December 14, 1978, as amended June 29, 1983, a period of use of two years or 24,000 miles, whichever first occurs, and for all other warranted parts, a period of use of five years or 50,000 miles, whichever first occurs.

(G) ~~(F)~~ In the case of all other light-duty, medium-duty and heavy-duty vehicles, and motor vehicle engines used in such vehicles, a period of use of five years or 50,000 miles, whichever first occurs.

Amend Section 2035(c)(1)(G)(2) to read as follows:

(2) "Warranted part" means any emissions-related part installed on a motor vehicle or motor vehicle engine by the vehicle or engine manufacturer which is included on the "Emissions Warranty Parts List" required by Section 2036~~(b)~~(c) and approved for the vehicle or engine by the ~~Executive Officer~~ executive officer.

Amend Section 2036(c) to read as follows:

(c) Commencing with 1980 models sold on or after September 1, 1979, furnish with each new vehicle or engine a list of the "warranted parts" installed on that vehicle or engine. The list shall include those parts included on the Air Resources Board "Emissions Warranty Parts List," dated December 14, 1978, as amended on June 29, 1983, and incorporated herein by reference.

Amend Section 2039 to read as follows:

2039. This section shall apply to passenger cars, light-duty trucks, ~~and~~ medium-duty and heavy-duty vehicles and motorcycles required to be inspected pursuant to ~~the-Motor-Vehicle-Inspection-Program-(MVIP)-established-pursuant to-Section-9889.50-et-seq.,-of-the-California-Business-and-Professions-Code~~ any statutorily authorized motor vehicle emissions inspection and maintenance program. The provisions of this section shall be contained in the warranty statement required pursuant to Section 2036(d).

(a) The owner of such a vehicle which fails in the inspection during its useful life may choose to have the vehicle repaired at a warranty station.

(1) If the warranty station identifies that the ~~MVIP~~ inspection failure was caused by the failure or malfunction of a "warranted part", then the vehicle manufacturer shall be liable for all expenses involved in detecting and correcting the part failure or malfunction, unless the warranty station demonstrates that the part failure or malfunction was caused by abuse, neglect, or improper maintenance as specified in Subsection 2041(a), or was caused by an improper adjustment as specified in Subsection 2041(b).

(2) If the warranty station demonstrates that the ~~MVIP~~ inspection failure was caused by one or more of the conditions excluded from warranty coverage pursuant to Section 2041, the vehicle owner shall be liable for all diagnostic and repair expenses. Such expenses shall not exceed the maximum repair costs permissible under the ~~MVIP~~ inspection program.

(3) If the warranty station identifies that the ~~MVIP~~ inspection failure was caused by one or more defects covered under warranty pursuant to these regulations in combination with one or more conditions excluded from warranty coverage pursuant to Section 2041, then the vehicle owner shall not be charged for that portion of the diagnostic and repair costs related to detecting and repairing the warrantable defects.

(b) In the alternative, the owner of a vehicle which fails an ~~MVIP~~ inspection may choose to have the vehicle repaired somewhere other than at a warranty station. If a warrantable defect is found, the vehicle owner may deliver the vehicle to a warranty station and have the defect corrected free of charge. The vehicle manufacturer shall not be liable for any diagnostic expenses incurred at a service establishment not authorized to perform warranty repairs, except in the case of an emergency as specified in subsection 2037(d).

NOTE: Authority cited: Sections 39600 and 39601, Health and Safety Code. Reference: Sections 43106 and 43204, Health and Safety Code.

Attachment II

State of California
AIR RESOURCES BOARD

December 14, 1978
Amended June 30, 1983

Emissions Warranty Parts List

I. Fuel Metering System

- A. Carburetor and internal parts (or fuel injection system)*
- B. Air/fuel ratio feedback and control system
- C. Cold start enrichment system*

II. Air Induction System

- A. Controlled hot air intake system
- B. Intake manifold
- C. Heat riser valve and assembly
- D. Turbocharger systems

III. Ignition System

- A. Distributor and internal parts*
- B. Spark advance/retard system
- C. Spark plugs*
- D. Ignition coil and/or control module
- E. Ignition wires*

IV. Evaporative Control System

- A. Vapor storage canister
- B. Vapor-liquid separator
- C. Fuel tank and filler cap

V. Positive Crankcase Ventilation (PCV) System

- A. PCV valve
- B. Oil filler cap

VI. Exhaust Gas Recirculation (EGR) System

- A. EGR valve body, and carburetor spacer if applicable
- B. EGR rate feedback and control system

VII. Air Injection System

A. Air pump
B. Valves affecting distribution of flow
C. Distribution manifold

VIII. Catalyst or Thermal Reactor System

A. Catalytic converter & constricted fuel filler neck
B. Thermal reactor
C. Exhaust manifold
D. Exhaust portliner and/or double walled exhaust pipe

IX. Miscellaneous Items Used in Above Systems

A. Hoses, clamps, fittings and, tubing, sealing gaskets or devices, and mounting hardware*
B. Pulleys, belts and idlers*
C. Vacuum, temperature, and time sensitive valves and switches
D. Electronic controls

* These items are warranted for two years or 24,000 miles, whichever first occurs, if the vehicle was certified to the optional emission standards pursuant to Section 1960.15, Title 13, California Administrative Code, and sold on or after January 1, 1983. The warranty period for other items or vehicles is specified in Section 2035 of Title 13.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Amendments to Title 13, California Administrative Code, Sections 2035 and 2039 regarding Warranty of Emissions-Related Parts and the December 14, 1978 Emissions Warranty Parts List Incorporated in Section 2036

Agenda Item No.: 83-9-1

Public Hearing Date: June 29, 1983

Response Date: June 29, 1983

Issuing Authority: Air Resources Board

Comment: Although increased exhaust emissions from some motor vehicles may result from the regulatory amendments regarding warranty coverage, there are no feasible alternatives or mitigation measures available to reduce such potential adverse air quality impacts from the amendment reducing warranty coverage consistent with Health and Safety Code Section 43204. In all other respects, the regulatory amendments will not result in potential adverse environmental impacts.

Response: N/A

CERTIFIED: Harold Holmes
Board Secretary

Date: 11/22/83

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject : Filing of Notice of Decisions of the Air Resources Board

From : Harold Holmes
Board Secretary
Air Resources Board

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
83-14
83-15
[redacted]
83-21
83-22
83-24

RECEIVED BY
Office of the Secretary
DEC 0 6 198[illegible]
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution No. 83-18

June 30, 1983

WHEREAS, James G. Leathers has served with distinction as a member of the Air Resources Board from September 1979 through June 1983;

WHEREAS, as a rice grower and active member of California's agricultural community, Jim has worked persistently and enthusiastically for the well-being of every Californian by urging all segments of society to share the load and do their part to clean up the air;

WHEREAS, his equanimity, sense of fairness, and solid judgment have allowed him to pierce through complex technical issues towards the goal of clean and healthy air;

WHEREAS, Jim's integrity, forthrightness, and sense of humor have been instrumental in seeing the Board through many challenges, including the development of innovative agricultural burning regulations, the adoption of stringent ambient air quality standards, the implementation of trend-setting gasoline and diesel motor vehicle emission standards, and the initiation of a program to control toxic air contaminants;

WHEREAS, Jim has demonstrated his special concern for California's agriculture by serving as Chairman of the ARB's Agricultural Advisory Committee and by leading a successful campaign to educate growers, workers, and consumers alike about the effects of air pollution on crops and vegetation; and

WHEREAS, Jim is a pleasure to work with and has fostered mutual respect and understanding between the staff of the ARB and our colleagues at the Air Pollution Control Districts.

NOW, THEREFORE BE IT RESOLVED that the Air Resources Board extends its deepest appreciation to Jim Leathers and expresses its thanks for his contribution to California's progress towards clean air.

Gordon Duffy, Chairman

Laurence S. Caretto, Member

Tirso del Junco, Member

Betty S. Ichikawa, Member

John F. Doyle, Member

Tom Hamilton, Member

J. Gordon Kennedy, Member

State of California
AIR RESOURCES BOARD

Resolution 83-19
July 29, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1219-100 entitled "Particulate and Gas Phase Mutagens in Ambient and Simulated Atmospheres" has been submitted by Statewide Air Pollution Research Center, University of California, Riverside to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1219-100 entitled "Particulate and Gas Phase Mutagens in Ambient and Simulated Atmospheres" submitted by the Statewide Air Pollution Research Center, University of California, Riverside for a total amount not to exceed $160,000;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1219-100 entitled "Particulate and Gas Phase Mutagens in Ambient and Simulated Atmospheres" submitted by the Statewide Air Pollution Research Center, University of California, Riverside for a total amount not to exceed $160,000; and

BE IT FURTHER RESOLVED, that the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein in an amount not to exceed $160,000.

I hereby certify that the above is a true and correct copy of Resolution 83-19 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-11-2a
DATE: July 29, 1983

ITEM: Research Proposal No. 1219-100 entitled "Particulate and Gas Phase Mutagens in Ambient and Simulated Atmospheres".

RECOMMENDATION: Adopt Resolution 83-19 approving Research Proposal No. 1219-100 for funding in an amount not to exceed $160,000.

SUMMARY: Respirable particles in California's polluted air basins contain combustion-generated carcinogens such as benzo(a)pyrene (BaP). Furthermore, application of the Ames Salmonella typhimurium assay to extracts of ambient particulate organic matter (POM) has shown they contain strong, direct mutagens as well as promutagens such as BaP. Similar considerations apply to POM directly emitted from motor vehicles, especially those with diesel engines. There is also evidence for the existence of gaseous mutagens in urban atmospheres. Questions critical to risk-assessment evaluations of alternate control strategies for mutagenic species in the atmosphere include: what are the chemical structures of these mutagenic compounds, how are they formed and what are their concentrations in ambient POM? To begin to answer these questions a three-part program has been proposed.

1. Mutagenic and Chemical Composition of Particles in Ambient Air

Ambient particulate matter will be collected over a four-day period in September 1983 during a period of high photochemical activity. Samples will be collected at El Monte and at Riverside and on a schedule which permits study of diurnal changes. The particulate matter will be analyzed for mutagenicity, lead, bromine, total carbon, elemental carbon, sulfate, nitrate and various elements. Concurrent with these analyses, CO, NO, O_3, PAN, wind direction, wind velocity, temperature, dew point, light intensity, THC, NMHC and CH_4 will be measured continuously. The results from analyses of the particulate samples and the continuous monitoring will be analyzed for possible correlations of direct mutagenicity with co-pollutants.

2. Development, Optimization and Testing of Ames Assay for the Testing of Gas-Phase Mutagens and its Applications to Polluted Atmospheres

   Once the Ames test is optimized from gas-phase mutagens, testing will be done using concentrated surrogate smog mixtures generated in the SAPRC chambers. Initially dark and irradiated hydrocarbon/NOx mixtures will be used. Subsequently individual gaseous pollutants suspected of being mutagenic, such as HONO, PAN, NO_2 and O_3, will be tested using the same exposure system as in the smog chamber experiments described above.

3. Investigation of the Mutagenicities of Model Peroxycompounds Utilizing the New Ames Strain TA 102

   The investigation will evaluate the suitability of the new Ames tester strain TA 102 for the mutagenic detection of peroxycompounds such as endoperoxides, hydroperoxides, and peracids; these might serve as model compounds for oxymutagens formed by atmospheric reactions of singlet oxygen and hydrogen peroxide with PAHs, olefins, and aromatic acids, respectively.

This project will substantially improve the capabilities of the ARB, local air pollution control districts and others to assess possible risks to public health due to toxic air contaminants and thereby help to distinguish insignificant or acceptable risks from unacceptable risks. In addition, where unacceptable risks may occur, the information obtained will help to establish a scientifically sound and defensible basis for public policy action to mitigate excessive risks.

State of California
AIR RESOURCES BOARD

Resolution 83-20
July 29, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1217-100 (R) entitled "Optimization and Performance Evaluation of Catalytic Trap Oxidizer for Exhaust Particulate Reduction on Diesel Buses" has been submitted by Johnson Matthey Inc. to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1217-100 (R) entitled "Optimization and Performance Evaluation of Catalytic Trap Oxidizer for Exhaust Particulate Reduction on Diesel Buses" submitted by Johnson Matthey Inc. for a total amount not to exceed $90,071;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1217-100 (R) entitled "Optimization and Performance Evaluation of Catalytic Trap Oxidizer for Exhaust Particulate Reduction on Diesel Buses" submitted by Johnson Matthey Inc. for a total amount not to exceed $90,071; and

BE IT FURTHER RESOLVED, that the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein in an amount not to exceed $90,071.

I hereby certify that the above is a true and correct copy of Resolution 83-20 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-11-2b
DATE: July 29, 1983

ITEM: Research Proposal No. 1217-100 (R) entitled "Optimization and Performance Evaluation of Catalytic Trap Oxidizer for Exhaust Particulate Reduction on Diesel Buses".

RECOMMENDATION: Adopt Resolution 83-20 approving Research Proposal No. 1217-100 (R) for funding in an amount not to exceed $90,071.

SUMMARY: Particulate emissions from diesel engines are a significant air pollution concern because of the potential carcinogenic hazards posed by these emissions, their potential to reduce visibility, and their soiling effects on materials. While devices to reduce particulate emissions from light-duty diesel engines have been extensively studied and are expected to be in commercial service by 1986, this technology has not been fully demonstrated for heavy-duty diesel engines.

In order to evaluate the current technology, the ARB staff has suggested a demonstration of particulate controls on a transit coach. The engines used on buses are predominantly two-cycle, direct injection types; they are generally larger and have lower exhaust temperatures than diesel engines in automobiles. They also produce significantly larger quantities of polynuclear aromatic hydrocarbons in their exhaust.

The Manufacturers of Emission Controls Association (MECA) was contacted by the ARB regarding participation in the transit coach demonstration of a particulate trap and regeneration system, and they in turn solicited interest from the manufacturers who produce these devices and systems. Three respondents expressed interest, but only one, Johnson Matthey, is able to provide both a trap and regeneration system. Engine dynamometer testing at Southwest Research Institute has shown that a regeneration system is essential for trap operation with the diesel engine used in most transit coaches. Both Corning and NGK-Locke can provide only a trap system. At this time, regeneration technology is not available from the latter manufacturers.

This proposed study seeks to obtain baseline emissions data on a representative diesel-powered bus, to scale up and optimize the performance of a Johnson Matthey Catalytic Trap Oxidizer for this engine, and to evaluate performance of the engine and Catalytic Trap Oxidizer in normal bus service for a period of about six months. The results from this study will greatly assist the ARB staff in evaluating the technical feasibility and cost effectiveness of fitting Catalytic Trap Oxidizers to new and existing bus engines as a means of improving air quality.

State of California
AIR RESOURCES BOARD

Resolution 83-21

July 28, 1983

Agenda Item No. 83-10-1

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Section 43100 of the Health and Safety Code authorizes the Board to certify new motor vehicles;

WHEREAS, Section 43102 of the Health and Safety Code, as amended in 1981 (stats 1981, ch 1185; AB 965), directs the Board to adopt certification and enforcement regulations, no later than for the 1983 model year, which will allow a manufacturer to certify in California federally certified light-duty motor vehicles which are unavailable in this state provided that their emissions are offset by the manufacturer's California-certified vehicles whose emissions are below the applicable California standard;

WHEREAS, in 1982 the Board adopted "Guidelines for Certification of 1983 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California," (the "Guidelines") and adopted Section 1960.5 and amended Section 2061, Title 13, California Administrative Code, which incorporate the Guidelines, to implement AB 965 for the 1983 model year;

WHEREAS, the California Environmental Quality Act (CEQA) and Board regulations require that no project having significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code; and

WHEREAS, the Board finds that:

The 1983 model year program for certification of federally certified light-duty vehicles for sale in California has enabled manufacturers to offer otherwise unavailable models in California;

Extension of the present program with minor technical changes would continue to enable sale of otherwise unavailable models in future years;

While the adverse emissions impact of the program for the 1983 model year is negligible, extension of the program on a permanent basis could result in a cumulative significant adverse emissons impact in later years as more federally certified vehicles join the California fleet; and

The measures contained in the program approved herein which limit federally certified vehicles certified for sale in California to those necessary to satisfy the unavailability problem, and which extend the program only through the 1987 model year, mitigate the adverse emissions impact to the maximum extent currently feasible; no additional mitigation measures or alternatives which meet the requirements of AB 965 and would eliminate or substantially further reduce any significant adverse environmental impact are currently available.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves amendments to:

Section 1960.5, Title 13, California Administrative Code, as set forth in Attachment A;

Section 2061, Title 13, California Administrative Code, as set forth in Attachment B; and

"Guidelines for Certification of 1983 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California", as set forth in Attachment C;

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to adopt the amendments set forth in Attachments A, B, and C after making them available to the public for a period of 15 days, provided, however, that the Executive Officer shall consider such written comments as may be submitted during this period, and shall present the regulations to the Board for further consideration if he determines that this is warranted in light of the written comments received.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to report annually to the Board on the effect of the program approved herein on model availability and vehicular emissions.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to prepare for formal Board consideration amendments to the Guidelines which would provide for offsetting of particulate emissions.

BE IT FURTHER RESOLVED that the Board finds that the regulations as approved and amended herein, individually and in the aggregate with the other California motor vehicle emission regulations, are at least as protective of public health and welfare as comparable federal regulations and are consistent with Section 202(a) of the federal Clean Air Act.

I certify that this is a true and correct copy of Resolution 83-21 as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

ATTACHMENT A

Proposed Amendment to Section 1960.5 of
Title 13, California Administrative Code

Amend Section 1960.5, Title 13, California Administrative Code, as follows:

1960.5. Certification of 1983 ~~and/Subsequent~~ through 1987 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California.

(a) The exhaust emissions from new 1983 ~~and/Subsequent~~ through 1987 model year federally certified passenger cars and light-duty trucks, subject to registration and sold and registered in this state pursuant to Section 43102(b) of the California Health and Safety Code, shall not exceed the applicable federal emissions standards as determined under applicable federal test procedures.

(b) With respect to any new vehicle required to comply with the standards set forth in paragraph (a), the manufacturer's written maintenance instructions for in-use vehicles shall not require scheduled maintenance more frequently than or beyond the scope of maintenance permitted under the test procedures referenced in paragraph (a). Any failure to perform scheduled maintenance shall not excuse an emissions violation unless the failure is related to or causes the violation.

(c) The standards and procedures for certifying in California 1983 ~~and/Subsequent~~ through 1987 model year federally certified light-duty motor vehicles are set forth in "Guidelines for Certification of 1983 ~~and/Subsequent~~ through 1987 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California", adopted July 20, 1982, as last amended _____.

NOTE: Authority cited: Sections 39601, 43100 and 43102, Health and Safety Code. Reference: Section 43102, Health and Safety Code.

ATTACHMENT B

Proposed Amendment to Title 13, California Administrative Code

Amend Section 2061, Title 13, California Administrative Code, as follows:

2061. Assembly-Line Test Procedures--1983 and Subsequent Model Years.

New 1983 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles subject to certification and manufactured for sale in California shall be tested in accordance with the "California Assembly-Line Test Procedures for 1983 and Subsequent Model Year Passenge Cars, Light-Duty Trucks and Medium-Duty Vehicles,", adopted November 24, 1981, including federally certified light-duty motor vehicles, except as provided in "Guidelines for Certification of 1983 ~~and Subsequent~~ through 1987 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California", adopted July 20, 1982, as last amended _____.

NOTE: Authority cited: Sections 39515, 39601 and 43210, Health and Safety Code. Reference: Sections 43102, 43105, 43210, 43211 and 43212, Health and Safety Code.

GUIDELINES FOR CERTIFICATION OF 1983 ~~AND/SUBSEQUENT~~ THROUGH 1987 MODEL YEAR FEDERALLY CERTIFIED LIGHT-DUTY MOTOR VEHICLES FOR SALE IN CALIFORNIA

I. APPLICABILITY

These guidelines adopted pursuant to Section 43102(b) of the California Health and Safety Code are applicable to 1983 ~~and/subsequent~~ through 1987 model year federally certified light-duty motor vehicles proposed for sale in California. These guidelines are not applicable to medium-duty trucks, motorcycles, heavy-duty engines, heavy-duty vehicles, emergency vehicles, or vehicles with engines having a displacement less than 50 cubic inches.

II. DEFINITIONS

For the purposes of these guidelines:

1. "Light-duty motor vehicle" means a vehicle having a manufacturer's maximum gross vehicle weight rating of under 6,001 pounds (California Health and Safety Code Section 39035).
2. "California vehicle" means a motor vehicle originally certified in California by an Executive Order.
3. "Equivalent inertia weight (EIW)" is defined under subparagraph 86.129-79(a), Title 40, Code of Federal Regulations.
4. "Federal vehicle" means a motor vehicle originally certified federally by a Certificate of Conformity.
5. "Model" means a unique combination of car line, basic engine, and transmission class, or as defined by a manufacturer with the approval of the Executive Officer.
6. "Car Line" means a name denoting a group of vehicles within a make or car division which has a degree of commonality in

construction (e.g., body, chassis). Car line does not consider any level of decor or opulence and is not generally distinguished by characteristics as roof line, number of doors, seats, or windows, except for station wagons or light-duty trucks. Station wagons and light-duty trucks are considered to be different car lines than passenger cars.

7. "Basic Engine" means a unique combination of manufacturer, engine displacement, number of cylinders, fuel system (as distinguished by use of carburetor or fuel injection), and catalyst usage.

8. "Transmission Class" means a group of transmissions having the following common features: basic transmission type (manual, automatic, or semi-automatic), number of forward speeds (e.g., manual four-speed, three-speed automatic, two-speed semi-automatic).

III. CERTIFICATION OF FEDERAL VEHICLES

To receive certification for federal vehicle sales in California, a manufacturer shall:

A. Provide to the Executive Officer evidence of federal certification, and a statement that the model(s) for which certification is requested are not available in California.

B. Provide a ~~five-year/50,000-mile~~ warranty on emissions-related parts in accordance with Sections 2035 et seq., Title 13, California Administrative Code, as they apply to vehicles certified under the primary California standards. However, Ffederal vehicles which are offset by California vehicles certified to a 100,000-mile optional standard shall provide a ten-year/100,000-mile warranty.

C. Provide: 1) certification emission levels of federal models intended for sale in California, 2) quarterly production reports, by model and engine family, of vehicles intended for sale or sold in California, and 3) other information which the Executive Officer deems necessary to calculate emissions offset credits, emission deficits, or air quality impacts.

D. Label each vehicle on the assembly-line with the statement "conforms to federal regulations and is certified for sale in California" to distinguish federal vehicles certified for sale in California from other federal ~~vehicles~~ and ~~from~~ California vehicles.

IV. ASSEMBLY-LINE AND ENFORCEMENT TESTING

A. All federal vehicles certified and intended for sale in California shall comply with all provisions of the applicable California Assembly-Line Test Procedures, except that:

1. The Executive Officer, at his or her discretion, may accept quality audit emissions data from other sources in lieu of a 2 percent quality audit of federal vehicle production intended for sale in California.

2. Manufacturers which have projected sales of less than 1,000 federal vehicles per model year in California shall be exempt from the 2 percent quality audit requirement. However, such manufacturers shall submit to the Executive Officer any other similar data which may be available.

3. Data submitted in lieu of 2 percent quality audit data shall be accompanied either by a statement that the data were generated according to California Assembly-Line Test Procedures, or by a description of how the testing and analysis procedures used depart from California Assembly-Line Test Procedures.

4. ~~3.~~ The Executive Officer, at his or her discretion, may waive the requirement for 100 percent steady state emissions testing of federal vehicles intended for sale in California in cases where lack of test facilities or other factors would place undue burden on vehicle manufacturers.

B. All federal vehicles certified for sale in California shall be subject to the compliance testing requirements of Title 13, California Administrative Code.

V. OFFSETTING PROCEDURE

A. Emissions offsetting shall be limited as follows:

1. By manufacturer. A manufacturer shall not trade, sell, transfer, or in any other manner exchange emissions credits with another manufacturer, except that a manufacturer which supplies engines to a vehicle manufacturer may also supply offsetting emission credits if the vehicle manufacturer's total production for California is less than 200 units per model year.

2. By vehicle category. Vehicle categories are: (a) passenger cars and (b) light-duty trucks (less than 6,001 pounds gross vehicle weight rating). Emission credits from vehicles in one category shall not offset vehicles in the other category.

3. By fuel type. Offsetting shall be conducted only among vehicles with like fuels (e.g., gasoline to gasoline, diesel to diesel, etc.).

4. By durability option. Federal vehicles which are offset by California vehicles certified to the optional 100,000-mile emissions standards must demonstrate 100,000-mile durability, or the equivalent, subject to the approval of the Executive Officer.

5. By model. No federally certified vehicle shall be certified or sold in California if a comparable California model ~~vehicle~~ of the same manufacturer is offered ~~for the 1983~~ in the same model year.

6. By pollutant. Oxides of nitrogen (NOx) is the only pollutant which may be offset for passenger cars. Hydrocarbons, carbon monoxide, and NOx may be offset for light-duty trucks. Evaporative hydrocarbons and particulates are not eligible for offsets. Total hydrocarbon data shall be compared directly to non-methane hydrocarbon data for purposes of calculating offsets.

B. Each manufacturer shall submit to the Executive Officer by October 1 of each year, or as soon thereafter as is practicable: (1) an estimate of the emissions credits which it will accrue based upon California certified emissions levels and projected sales of California vehicles; and (2) an estimate of the emissions credits which it will use based upon federal certification emissions levels and estimated sales of federal vehicles in California. These estimates may be changed at any time within the model year, subject to the approval of the Executive Officer.

C. Within the bounds of Part A, emissions credits that can be accrued by a California certified vehicle shall be the difference between the applicable California standard and the certification emissions level~~.~~.

$$\text{Estimated Credits} = \sum_{i=1}^{m} \text{Calsales}_i \, (\text{Calstd} - \text{Calcert}_i)$$

Where:

m = Number of California engine families certified to a set of California standards (passenger cars, 0-3999 pounds EIW trucks, 4000-5999 pounds EIW trucks) for a given manufacturer.

Calsales = Manufacturer's projected sales by engine family.

Calstd = Applicable California standard.

Calcert = California engine family certification level listed on the Executive Order for the applicable engine family.

D. Within the bounds of Part A, the emissions required to offset a federal vehicle shall be the difference between the federal certification level and the sales-weighted mean certification level of all California engine families (Calmean) as of February 1~~,~~ ~~1982,~~ of the previous model year for passenger cars or the appropriate light-duty truck group as applicable. When a new standard is implemented, an estimated Calmean shall be determined at 80 percent of the new standard. The estimated Calmean shall be applicable, for the initial model year under the new standard only.

$$\text{Estimated Withdrawals} = \sum_{j=1}^{n} \text{Fedsales}_j \, (\text{Fedcert}_j - \text{Calmean})$$

Where: n = Number of unavailable passenger car and light-duty trucks by model types.

Fedsales = Estimated sales of unavailable federal model types in California for a given model year.

Fedcert = Federal certification level of the engine family containing the unavailable model. Federal certification level shall be taken as the highest level, for each pollutant, of any emission data vehicle in an engine family.

Calmean = Sales weighted mean certification emission level of all California engine families (industry-wide) within the appropriate standards category.

E. The estimates referred to in Parts B, C, and D shall be corrected at year-end using vehicle production and assembly-line emissions data, if available.

F. For the purposes of withdrawals, the 0 to 3,999 lbs. and 4,000 to 5,999 lbs. EIW groups may be combined for light-duty trucks.

G. Manufacturers shall individually be limited to withdrawing the following percentages of accured credits for offsetting federal vehicles:

Passenger Car NOx	- 8%
Light-Duty Truck HC	- 74%
Light-Duty Truck CO	- 17%
Light-Duty Truck NOx	- 39%

State of California
AIR RESOURCES BOARD

Public Hearing to Consider Amendments to Sections 1960.5 and 2061, Title 13, California Administrative Code, and Amendment of the Document Incorporated in Those Sections, Regarding Certification of Federally Certified Light-Duty Motor Vehicles for Sale in California

Hearing Date: July 28, 1983
Public Availability Date: August 16, 1983

On July 28, 1983, the Air Resources Board approved amendments to Sections 1960.5 and 2061, Title 13, California Administrative Code, and to its "Guidelines for Certification of 1983 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California" (the "Guidelines"), which are incorporated in those sections. Attached is a copy of the Board's Resolution 83-21, approving these amendments.

The approved amendments contain certain modifications to the language originally proposed by staff. Appended to Resolution 83-21 are the approved amendments to Sections 1960.5 and 2061, and to the Guidelines, showing deletions from the originally proposed language in slashes, and additions in double underline.

In approving the amendments, the Board directed the Executive Officer to adopt the amendments after making them available to the public for a period of 15 days, provided, however, that the Executive Officer shall consider such written comments as may be submitted during this period, and shall present the regulations to the Board for further consideration if he determines that this is warranted in light of the written comments received. Any written comments must be received by August 31, 1983, to be considered.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Amendments to Sections 1960.5 and 2061, Title 13, California Administrative Code, and the Amendment of Documents Incorporated in Those Sections, Regarding the Certification of Federally Certified Motor Vehicles for Sale in California.

Agenda Item No: 83-10-1

Public Hearing Date: July 28, 1983

Response Date: August 16, 1983

Issuing Authority: Executive Officer

Comment: The only comment raising any environmental issues associated with the proposed action was made by the American Motors Corporation (AMC). AMC commented that amending the regulations to permit offsetting credits between vehicle categories could result in an air quality benefit.

Response: Staff has determined that this issue is not significant. The AMC proposal would likely cause increased emissions because the increased use of offsetting credits to certify federally certified vehicles for sale in California is likely to result in an air quality detriment rather than an air quality benefit.

Certified: _____
Executive Officer

Date: 9-16-83

RECEIVED BY
Office of the Secretary

DEC 0 6 1983

Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject : Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
83-14
83-15
83-16
[redacted]
83-22
83-24

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution 83-22

July 29, 1983

Agenda Item No.: 83-11-1

WHEREAS, the Legislature in 1982 enacted the Kapiloff Acid Deposition Act (Stats 1982, Ch. 1473; Health and Safety Code Sections 39900-39915) to address the problem of acid deposition in California;

WHEREAS, in the Kapiloff Acid Deposition Act the Legislature declared that acid deposition from anthropogenic sources in California has the potential for significant adverse effects on the environment, on the economy, and on public health;

WHEREAS, the Kapiloff Acid Deposition Act directs the Air Resources Board (the "Board") to coordinate and collect research and monitoring data on acid deposition;

WHEREAS, the Board in January of 1981 conducted a Symposium on Acid Precipitation in California and has conducted and funded initial monitoring and research studies which indicate that acid deposition, including acid rain, acid fog, and other forms of acid precipitation, occur at various times and locations throughout California;

WHEREAS, a proposed comprehensive research and monitoring program, including a five-year plan and a priority first-year plan to meet the research and monitoring goals and objectives set forth in the Kapiloff Acid Deposition Act, has been developed by Board staff and endorsed by the State Agency Working Group on Acid Deposition pursuant to Health and Safety Code Sections 39906 and 39907;

WHEREAS, the Kapiloff Acid Deposition Act authorizes the Board to require local air pollution control districts and air quality management districts, beginning July 1, 1983, to impose additional variance and permit fees on major nonvehicular emission sources of sulfur oxides and nitrogen oxides in order to recover a portion of the costs of the acid deposition research and monitoring program (Health and Safety Code Sections 39910-39914);

WHEREAS, the Board, after reviewing the status and staff recommendations regarding the current and planned acid deposition research program, has adopted Resolution 83-6, dated April 21, 1983, stating its intention to consider a proposal that would establish regulations to require districts to adopt an acid deposition fee program in Fiscal Year 1983-84;

WHEREAS, the Board staff has held workshops with industry and has met and conferred with representatives of local air pollution control districts and with their assistance has developed a proposed fee program which specifies the amount of fee collection that would be required by each district and has also developed a uniform sample fee schedule which may be considered for adoption by each district;

WHEREAS, the proposed fee program has been designed to provide the Air Pollution Control Fund with net revenues of one million dollars ($1,000,000) exclusive of administrative costs in Fiscal Year 1983-84, which is the lesser of either one million dollars ($1,000,000) or the amount that has been appropriated by the Legislature from the Motor Vehicle Account and California Environmental License Plate Fund for acid deposition research, as required by the Kapiloff Acid Deposition Act;

WHEREAS, the proposed fee program for Fiscal Year 1983-84 is based on sulfur oxides and nitrogen oxides emission data from major permitted nonvehicular sources, as provided in the Kapiloff Acid Deposition Act, and the proposed regulations and sample fee schedule are based on the most current annual emissions data available from the districts, which are for calendar year 1982;

WHEREAS, the Board has determined that the proposed fee program will not cause economic hardship on either the affected sources or on consumers who may ultimately bear the costs or on the districts, which are authorized to recover the administrative costs of collecting the fees;

WHEREAS, a duly noticed public hearing has been held in accordance with the California Administrative Procedure Act, and the Board has received and considered written and oral testimony from the affected industries, air pollution control districts, and the general public; and

WHEREAS, the Board has determined, pursuant to the requirements of the California Environmental Quality Act and Air Resources Board regulations, that this regulatory action will have no significant adverse effect on the environment.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves the regulations set forth in Attachment A, which establish a fee program and require local air pollution control districts and air quality management districts to collect fees, as authorized by the Kapiloff Acid Deposition Act, to provide funds for acid deposition research and monitoring.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to adopt the amendments set forth in Attachment A after making them available to the public for a period of 15 days, provided, however, that the Executive Officer shall consider such written comments as may be submitted during this period, and shall present the regulations to the Board for further consideration if he determines that this is warranted in light of the written comments received.

BE IT FURTHER RESOLVED that the Board approves the sample fee schedule set forth in Attachment B for consideration by those local air pollution control districts and air quality management districts which are required to collect fees for acid deposition research pursuant to the regulations attached hereto.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to forward the attached regulations and model fee schedule to the specified districts for appropriate action, and to the Department of Finance, the Legislative Analyst, and the State Controller for information and for appropriate action.

BE IT FURTHER RESOLVED that in order to allow the districts sufficient time to adopt regulations to implement the acid deposition fee program, it is the intent of the Board that the regulations set forth in Attachment A become effective immediately upon filing with the Secretary of State.

BE IT FURTHER RESOLVED that the Board intends to review in 1984 the status of the acid deposition research and monitoring program and to reconsider at that time the renewal and modification, as necessary, of the proposed fee program for major nonvehicular sources in order to reflect legal requirements, changes in program needs and capabilities, changes in base year emissions, and such other factors as may influence acid deposition research and funding requirements.

I certify that the above is a true and correct copy of Resolution 83-22 as adopted by the Air Resources Board.

Harold Holmes

(Harold Holmes, Board Secretary

ATTACHMENT A

Subchapter 3.5. Acid Deposition Fee Program

Article 1. Fee Program to be Implemented by Air Pollution Control Districts and Air Quality Management Districts for Fiscal Year 1983-1984.

90600. General Requirements. To provide revenue for acid deposition research and monitoring for fiscal year 1983-84, each district identified in Section 90601 shall adopt regulations, with an effective date no later than ~~October~~ December 15, 1983, which provide for the collection of fees from the holders of permits for sources which emit 1,000 tons per year or more of either sulfur oxides or nitrogen oxides. The fees collected shall be in addition to permit and other fees already authorized to be collected from such sources and shall provide net revenues from each district, excluding collection costs and accrued interest, as specified in Section 90601. In no event shall such fees, including fees collected to cover the administrative costs to the district of collecting the fees, exceed twenty-five one-hundredths of one cent ($0.0025) per pound of sulfur oxides or nitrogen oxides emitted.

NOTE: Authority cited: Sections 39600, 39601, and 39910, Health and Safety Code. Reference: Sections 39002, 39500, 39600, and 39910-39914, Health and Safety Code.

90601. Fee Revenues. No later than March 1, 1984, each district specified in this section shall transmit to the California State Controller, for deposit into the Air Pollution Control Fund, net revenues, exclusive of district administrative costs and accrued interest, if any, in the amounts specified:

(a) Bay Area Air Quality Management District: ~~two hundred forty-seven thousand one-hundred dollars ($247,100);~~ one hundred ninety-five thousand nine hundred dollars ($195,900);

(b) South Coast Air Quality Management District: ~~two hundred twenty-three thousand five-hundred dollars ($223,500);~~ two hundred sixty-two thousand nine-hundred dollars ($262,900);

(c) Kern County Air Pollution Control District: ~~two hundred twenty-six thousand five hundred dollars ($226,500);~~ two hundred thirty-nine thousand nine hundred dollars ($239,900);

(d) San Bernardino County Air Pollution Control District: ~~eighty-eight thousand three hundred dollars ($88,300);~~ seventy-eight thousand six hundred dollars ($78,600);

(e) Monterey Bay Unified Air Pollution Control District: ~~fifty-one thousand four hundred dollars ($51,400);~~ fifty-five thousand nine hundred dollars ($55,900);

(f) San Diego County Air Pollution Control District: ~~sixty-two thousand eight hundred dollars ($62,800);~~ fifty-nine thousand three hundred dollars ($59,300);

(g) Fresno County Air Pollution Control District: ~~forty-nine thousand two-hundred dollars ($49,200);~~ forty-eight thousand eight hundred dollars ($48,800);

(h) San Luis Obispo County Air Pollution Control District: ~~thirty-two thousand five hundred dollars ($32,500);~~ forty-three thousand six hundred dollars ($43,600);

(i) Ventura County Air Pollution Control District: ~~six thousand eight hundred dollars ($6,800);~~ ten thousand five hundred dollars ($10,500);

~~(j) Humboldt County Air Pollution Control District: seven thousand nine hundred dollars ($7,900);~~

(j) Stanislaus County Air Pollution Control District: four thousand six hundred dollars ($4,600);

~~(k) Stanislaus County Air Pollution Control District: four thousand dollars ($4,000).~~

NOTE: Authority cited: Sections 39600, 39601, and 39910, Health and Safety Code. Reference: Sections 39002, 39500, 39600, and 39910-39914, Health and Safety Code.

90602. Administrative Costs and Billing Information.

(a) To pay for the administrative costs of collecting the fees required by this article, each district may collect and retain fees, in addition to those specified in Section 90601, equal to the estimated cost of collecting the fees. ~~If the estimated cost of fee collection by the district exceeds two percent (2%) of the respective amount of fees specified in Section 90601, the district shall submit to the state board, no later than October 31, 1983, documentation to substantiate such administrative costs. In addition, each~~ Each district shall, upon request, submit to the state board within 30 days documentation to substantiate the administrative costs of collecting the fees required by this article.

(b) Each district shall submit to the state board, within 30 days of request, information relating to the assessed total tons of nitrogen oxides

and sulfur oxides, the amount of fees per pollutant collected from each major nonvehicular source, including fees to cover administrative costs, and the net amount of fees transmitted to the California State Controller, as set forth in Section 90601.

NOTE: Authority cited: Sections 39600, 39601, and 39910, Health and Safety Code. Reference: Sections 39002, 39500, 39600, and 39910-39914, Health and Safety Code.

90603. Exemption. In the event that any District is unable to collect the assessed acid deposition fee required by District rules and regulations from any source due to circumstances beyond the control of the District, including but not limited to plant closure or refusal of the source owner or operator to pay despite permit revocation and/or other enforcement action, such District shall notify the Executive Officer of the ARB, and for demonstrated good cause, may be relieved, on a prorated basis, from that portion of the fee collection requirement for the District, as set forth in 90601. Nothing herein shall relieve the owner or operator from any legal obligation to pay any fees assessed pursuant to district rules and regulations.

NOTE: Authority cited: Sections 39600, 39601, and 39910, Health and Safety Code. Reference: Sections 39002, 39500, 39600, and 39910-39914, Health and Safety Code.

Article 2. Fee Program to be Implemented by Air Pollution Control Districts and Air Quality Management Districts for Fiscal Year 1984-1985 and Subsequent Years

[Reserved.]

ATTACHMENT B

SAMPLE FEE SCHEDULE

I. RULE NO. ( ) SCHEDULE OF FEES FOR ACID DEPOSITION RESEARCH

A. DEFINITION OF MAJOR NONVEHICULAR SOURCE

For the purpose of this rule, major nonvehicular source shall mean any plant, building, structure, stationary facility or group of facilities under the same ownership, leasehold, or operator which, in the base calendar year, emitted to the atmosphere oxides of nitrogen or oxides of sulfur, expressed as nitrogen dioxide and sulfur dioxide, respectively, in an amount equal to or exceeding 1,000 tons.

B. FEE REQUIREMENTS FOR MAJOR SOURCES

1. For each major source, the permit holder is assessed a fee payable to (district), due within 60 days of notice of assessment by (district), and calculated according to the formula:

a. FEE AMOUNT = A + ~~B x ($3.175/ton)~~ (B x $3.687 per ton)

where:

A = administrative cost to district of fee collection, and

B = mass of emissions in the base year of oxides of nitrogen and/or oxides of sulfur, expressed as tons of nitrogen dioxide and sulfur dioxide, respectively, from the subject major source, and as determined by the Air Pollution Control Officer (Executive Officer) of (district).

b. In calculating the fee amount, emissions of either nitrogen oxides or sulfur oxides, if occurring in an amount of less than 1,000 tons per year, shall not be counted.

c. Notwithstanding Section (B)(1)(a), the fee amount, including district administrative costs, shall not exceed $0.0025 per pound (five dollars per ton) as specified by Health and Safety Code Section 39912.

2. Nonpayment of the assessed fees by the permit holder of a major source shall be cause for revocation of permit to operate or such other action as may be required by the Air Pollution Control Officer (Executive Officer) of the (district), consistent with current district practices for securing fee payment.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider the Adoption of a New Subchapter 3.5, "Acid Deposition Fee Program," into Title 17, California Administrative Code, Sections 90600-90603, and to Consider Approval of a Sample Fee Schedule

Agenda Item No.: 83-11-1

Public Hearing Date: July 29, 1983

Response Date: August 24, 1983

Issuing Authority: Executive Officer

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no adverse environmental effects.

Response: N/A

Certified: _____
Executive Officer

Date: 9/26/83

RECEIVED BY
Office of the Secretary

DEC 06

Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject : Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
83-14
83-15
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83-24

RECEIVED BY
Office of the Secretary
DEC 06 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution 83-23
August 26, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1220-101 entitled "Effects of SO_2 on Growth and Yield of Winter Crops Grown in California," has been submitted by the University of California, Riverside to the Air Resources Board;

WHEREAS, the Research staff has reviewed and recommended this proposal for approval;

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1220-101 entitled "Effects of SO_2 on Growth and Yield of Winter Crops Grown in California," submitted by the University of California, Riverside for a total amount not to exceed $70,407; and

WHEREAS, the Governor's Executive Order D-18-83 prohibits State agencies from awarding research contracts through October 31, 1983;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1220-101 entitled "Effects of SO_2 on Growth and Yield of Winter Crops Grown in California," submitted by the University of California, Riverside for a total amount not to exceed $70,407; and

BE IT FURTHER RESOLVED, that should an exemption from the prohibition contained in Executive Order D-18-83 on awarding contracts for research be granted, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein in an amount not to exceed $70,407.

I certify that the above is a true and correct copy of Resolution 83-23 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-12-6b1
DATE: August 26, 1983

ITEM: Research Proposal No. 1220-101 entitled "Effects of SO_2 on Growth and Yield of Winter Crops Grown in California".

RECOMMENDATION: Adopt Resolution 83-23 approving Research Proposal No. 1220-101 for funding in an amount not to exceed $70,407.

SUMMARY: Recent work in England showed that perennial ryegrass is more sensitive to SO_2 during the winter than the summer months. Yield reductions of perennial ryegrass were reported to occur after exposure to 0.02 ppm SO_2 in winter and 0.04 ppm SO_2 in summer. Lettuce and wheat are two important California winter crops that may suffer reduced yields due to SO_2.

This proposed study will determine the relationship between exposure to sulfur dioxide in wintertime and effect on lettuce and wheat crops. The varieties used in this study will be Empire (lettuce) and Yecora Rojo (wheat), which are widely grown commercially in California. Lettuce and wheat seeds will be planted approximately November 1. Plants will be fumigated with the following pollutant treatments: 1) charcoal-filtered air; 2) ambient air; 3) filtered air plus 0.03 ppm SO_2; 4) filtered air plus 0.07 ppm SO_2; 5) filtered air plus 0.15 ppm SO_2; and 6) ambient air without a fumigation chamber so the chamber effects may be assessed. Fumigations will be done at the Air Resources Board fumigation facility at the University of California, Riverside. Pollution treatments will continue for 24 hours per day seven days per week for the duration of the growing season.

Plant parameters that will be recorded include injury, growth, yield and selected physiological processes. Visual leaf symptoms will be assessed. Fresh and dry weight of stems and leaves will be used as a measure of plant growth at harvest time. Yield per pot will be evaluated on a marketable basis for each crop: weight and quality of lettuce heads and seed weight per plant and 100-seed weight of wheat plants. Photosynthesis and transpiration will be measured to determine differences among treatments.

State of California
AIR RESOURCES BOARD

Resolution 83-24

August 25, 1983

Agenda Item No. 83-12-2

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Section 43100 of the Health and Safety Code authorizes the Board to certify new motor vehicles;

WHEREAS, Section 43102 of the Health and Safety Code provides that no new motor vehicle shall be certified unless it meets specified emission standards and test procedures set by the state board;

WHEREAS, Sections 43013, 43101, and 43104 of the Health and Safety Code authorize the Board to adopt vehicle emission standards and test procedures in order to control or eliminate air pollution caused by motor vehicles;

WHEREAS, after public hearing and other administrative proceedings in accordance with the provisions of the Administrative Procedure Act, in 1981 the Board adopted optional transient certification procedures and exhaust emission standards for 1984 and subsequent model year heavy-duty engines and vehicles;

WHEREAS, the staff has proposed amendments to Section 1956.7, Title 13, of the California Administrative Code, regarding modification of the existing transient option to facilitate its use by manufacturers;

WHEREAS, the proposed amendments to Section 1956.7 would delay the naturally aspirated diesel engine crankcase emission requirement for one year and would substitute certain existing California labeling requirements for the labeling requirements of the federal transient procedures;

WHEREAS, the new labeling requirements proposed for heavy-duty engines using the optional standards and transient test procedures would be the same as those presently prescribed for heavy-duty vehicles using steady-state certification procedures and contained in the "California Motor Vehicle Tune-Up Label Specifications" as amended on June 16, 1983;

WHEREAS, the California Environmental Quality Act and Board regulations require that an activity not be adopted as proposed if the activity will have potentially significant adverse environmental impacts and alternatives or feasible mitigation measures are available which would substantially reduce or avoid such impacts;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code.

WHEREAS, the Board finds that:

The federal transient labeling requirements adopted by California for the 1984 model year could result in potential confusion among some vehicle owners as to mechanical warranty coverage provided by vehicle manufacturers;

Incorporating the labeling requirements contained in the "California Motor Vehicle Tune-Up Specifications" into the heavy-duty optional standards and transient test procedures would remove any potential labeling confusion and would not adversely impact manufacturers;

Appropriate control technology is not available for at least two heavy-duty engine families for the 1984 model year in order to comply with the crankcase emission control requirement associated with the optional standards;

Heavy-duty engine families already equipped with crankcase emission controls would retain such devices for the 1984 model year even if the regulatory requirement is delayed for one year;

A potentially significant adverse environmental impact may result from the proposed amendment to delay the effective date of the crankcase emission control requirement in that there may be an estimated maximum potential statewide emissions impact of 0.02 tons/day hydrocarbon, 0.03 tons/day carbon monoxide, 0.01 tons/day nitrogen oxides, and 0.04 tons/day particulate matter continuing for the lifetime of the affected 1984 model year vehicles;

There are no feasible alternatives or mitigation measures available to reduce this potential impact, and in all other respects the proposed amendments will not have significant adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED, that the Board hereby amends Section 1956.7, Article 2, Subchapter 1, Chapter 3 of Title 13, California Administrative Code, as set forth in Attachment A hereto.

BE IT FURTHER RESOLVED that the Board hereby amends the "California Exhaust Emission Standards and Test Procedures for 1982 and Subsequent Model Heavy-Duty Engines and Vehicles," as set forth in Attachment B hereto.

ATTACHMENT A

Amend Title 13, California Administrative Code, Sections 1956.7(a) and 1956.7(c), to read as follows:

1956.7 Exhaust Emission Standards and Test Procedures - 1981 and Subsequent Model Heavy-Duty Engines and Vehicles.

(a) The exhaust emissions from new 1981 and subsequent model heavy-duty engines, except engines used in medium-duty vehicles, shall not exceed:

Primary Exhaust Emission Standards
(grams per brake horsepower hour)

Model Year	Hydrocarbons	Carbon Monoxide	Hydrocarbons plus Oxides of Nitrogen
1981-1983	1.0	25	6.0
OR*	-	25	5
1984 and subsequent	0.5	25	4.5

*The two sets of standards for each model year are alternatives. A manufacturer has the option for each engine family of showing compliance with either set. Separate deterioration factors shall be established where applicable, for HC, CO, NOx and/or the combined emissions of HC and NOx.

The following optional exhaust emission standards are applicable to engines tested pursuant to the optional federal test procedures and regulations for 1984 and subsequent model heavy-duty engines. These standards replace the federal standards in Code of Federal Regulations Sections 86.084-10, 86.084-11, and 86.085-11 for hydrocarbons, carbon monoxide and oxides of nitrogen only.**

Optional Exhaust Emission Standards
(grams per brake horsepower hour)

Model Year	Hydrocarbons	Carbon Monoxide	Oxides of Nitrogen
1984 and subsequent	1.3	15.5	5.1

**The federal 13-mode optional standards for 1984 model-year diesel-powered engines do not apply. In addition, the engine crankcase emission control requirement in Subparagraph 86.084-11(b)(2)(c) shall not apply for the 1984 model year and shall apply to 1985 and later model year naturally aspirated diesel heavy-duty engines, except for turbocharged engines.

* * *

(c) The test procedures for determining compliance with standards applicable to 1982 and subsequent models are set forth in the "California Exhaust Emission Standards and Test Procedures for 1982 and Subsequent Model Heavy-Duty Engines and Vehicles", adopted October 5, 1976, as last amended ~~September 24, 1981~~ August 25, 1983.

* * *

NOTE: Authority cited: Section 39600 and 39601 Health and Safety Code. Reference: Sections 39002, 39003, 43000, 43013, 43100, 43101 and 43104, Health and Safety Code.

NOTE: Sections 1956.7(b), (d), and (e) remain in effect and are not changed by the above proposal.

ATTACHMENT B

State of California
AIR RESOURCES BOARD

Note: These procedures are printed in a style to indicate the adopted changes. New text is underlined and deleted portions are noted.

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1982 AND SUBSEQUENT MODEL HEAVY-DUTY ENGINES AND VEHICLES

Adopted: October 5, 1976
Amended: November 21, 1977
Amended: March 1, 1978
Amended: May 24, 1978
Amended: April 23, 1980
Amended: May 22, 1980
Amended: January 21, 1981
Amended: August 25, 1983

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1982 AND SUBSEQUENT MODEL HEAVY-DUTY ENGINES AND VEHICLES

The provisions of Subparts A and D, Part 86, Title 40, Code of Federal Regulations, as they pertain to heavy-duty engines and vehicles, and as they existed on April 15, 1977, are hereby adopted as the primary California Exhaust Emission Standards and Test Procedures for 1982 and Subsequent Model Heavy-Duty Engines and Vehicles. For manufacturers that elect to certify heavy-duty engines pursuant to the federal transient cycle test procedures and regulations for 1984 and subsequent years, the provisions of Subparts A and N, Part 86, Code of Federal Regulations promulgated January 21, 1980, are hereby adopted as optional "California Exhaust Emission Test Procedures and Regulations for 1984 and Subsequent Model Heavy-Duty Engines and Vehicles." The federal procedures are applicable with the following exceptions and additions:

A. Subsection A of this procedure is applicable to new 1982 and subsequent model heavy-duty engines and vehicles tested pursuant to the primary and optional test procedures and standards.

1. A manufacturer may elect to certify heavy-duty vehicles of 10,000 pounds maximum gross vehicles weight rating or less as medium-duty vehicles, in which event heavy-duty standards and test procedures will not apply.

2. Definitions.

a. "Administrator" means the Executive Officer of the Air Resources Board.

b. "Certificate of Conformity" means "Executive Order" certifying vehicles for sale in California.

c. "Certification" means certification as defined in Section 39018 of the Health and Safety Code.

d. "Heavy-duty engine" means an engine which is used to propel a heavy-duty vehicle.

e. "Heavy-duty vehicle" means any motor vehicle having a manufacturer's gross vehicle weight rating greater than 6,000 pounds, except passenger cars.

f. "Medium-duty vehicle" means any heavy-duty vehicle having a manufacturer's gross vehicle weight rating of 8500 pounds or less.

3. Any reference to vehicle or engine sales throughout the United States shall mean vehicle or engine sales in California.

4. Regulations concerning EPA hearings, EPA inspections, and specific language on the Certificate of Conformity, shall not be applicable to these procedures.

5. Labeling required pursuant to paragraph 86.079-35 for steady-state certification, labeling required pursuant to paragraph 86.084-35 for transient certification, and pursuant to Section 1965, Chapter 3, Title 13 of the California Administrative Code shall conform with the requirements specified in the "California Motor Vehicle Tune-Up Label Specifications".

6. ~~5.~~ Vehicle manufacturers shall affix a decal on each production vehicle in accordance with Section 43200 of the California Health and Safety Code.

B. Subsection B of this procedure is applicable to the primary test procedures and standards for all heavy-duty engines and vehicles:

1. For gasoline and diesel-powered engines and vehicles:

a. Durability data submitted pursuant to subparagraph 86.079-24(f) may be from engines previously certified by EPA or ARB.

b. The requirement in subparagraph 86.079-28(b)(4)(i)(B) (durability engines must meet emission standards) shall refer to federal emission standards.

~~c. Labeling required pursuant to paragraph 86.079-35 and Section 1965, Chapter 3, Title 13 of the California Administrative Code shall conform with the requirements specified in the "California Motor Vehicle Tune-Up Label Specifications."~~

c. ~~d.~~ A statement must be supplied that the production engines shall be in all material respects the same as those for which certification was granted.

d. ~~e.~~ The average brake horsepower at each mode shall be reported for all emission tests.

e. ~~f.~~ Engine manufacturers may apply durability and/or emission test data from 1979 and earlier model years towards certification for 1982 and subsequent models for similar engines, notwithstanding differences in the instrumentation. In the event that hydrocarbon emission data based on measurements from a nondispersive infrared analyzer are used pursuant to this section, such data shall be multiplied by a factor of 1.5 prior to comparison with the standards.

2. For gasoline-powered engines and vehicles only:

a. The mechanism for adjusting the idle air/fuel mixture, if any shall be designed so that either:

i. The mixture adjustment mechanism is not visible, even with the air cleaner removed, and special tools and/or procedures are required to make adjustments; or

ii. In the alternative, the Executive Officer may, upon reasonable notice to the manufacturer, require that a certification test of an engine or vehicle be conducted with the idle air/fuel mixture at any setting which the Executive Officer finds corresponds to settings likely to be encountered in actual use. The Executive Officer, in making this finding, shall consider the difficulty of making adjustments, damage to the carburetor in the event of any effort to make an improper adjustment, and the need to replace parts following the adjustment.

The manufacturer shall submit for approval by the Executive Officer the proposed method of compliance with this requirement in its preliminary application for certification.

The Executive Officer may, on a case-by-case basis, exempt from the requirements of this section engines which use carburetors substantially different in design from carburetors used on light or medium-duty vehicles and which the manufacturer demonstrates cannot be made to comply with this section within the available lead time. Such exemptions shall only apply to the 1982 model year.

b. A gasoline-powered vehicle manufacturer shall provide with the application:

i. Identification and description of the vehicle models for which certification is requested.

ii. Identification and description of the engines to be used in those vehicle models.

iii. Reference to the engine manufacturer's Executive Order certifying these engines.

c. If a gasoline-powered engine manufacturer requires the use of unleaded fuel, a statement will be required that the engine and transmission combinations for which certification is requested are designed to operate satisfactorily on a gasoline having a research octane number not greater than 91.

3. For diesel-powered heavy-duty engines only:

a. No durability fleet or smoke emission test will be required and any reference to durability testing shall be optional. No deterioration factor shall be used for calculating the emission test results. The 125 hour test shall be used to determine compliance with the emission standards.

b. Evidence must be submitted to the Executive Officer to demonstrate the durability of the emission control system. Such evidence may include durability test data and/or an engineering evaluation of the system. This evaluation shall be based on previous experience and/or similarity to previously certified systems.

C. Exhaust Emission Standards:

1. The following primary exhaust emission standards represent the maximum projected emissions from new heavy-duty gasoline engines and the maximum 125-hour test exhaust emissions from new heavy-duty diesel engines:

Primary Exhaust Emission Standards
(grams per brake horsepower hour)

Model Year	Hydrocarbons	Carbon Monoxide	Hydrocarbons Plus Oxides of Nitrogen
1982 - 1983	1.0	25	6.0
OR*		25	5
1984 and subsequent	0.5	25	4.5

*The two sets of standards for each model year are alternatives. A manufacturer has the option for each engine family of showing compliance with either set.

Separate deterioration factors shall be established, where applicable, for HC, CO, NOx, and/or the combined emissions of HC and NOx.

2. The following optional exhaust emission standards are applicable pursuant to the federal test procedure and regulations for 1984 and subsequent model heavy duty engines. These standards replace the federal standards in CFR Sections 86.084-10, 86.084-11, and 86.085-11 for hydrocarbons, carbon monoxide, and oxides of nitrogen, only.**

Optional Exhaust Emission Standards
(grams per brake-horsepower-hour)

Model Year	Hydrocarbons	Carbon Monoxide	Oxides of Nitrogen
1984 and Subsequent	1.3	15.5	5.1

** The federal 13-mode optional standards for diesel-powered engines for 1984 only are not applicable to California. In addition, the engine crankcase emission control requirement in Subparagraph 86.084-11(b)(2)(c) shall not apply for the 1984 model year and shall apply to 1985 and later model year naturally aspirated diesel heavy-duty engines, except for turbocharged engines.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: PUBLIC HEARING TO CONSIDER AMENDMENTS TO TITLE 13, SECTION 1956.7, CALIFORNIA ADMINISTRATIVE CODE, REGARDING A ONE YEAR DELAY OF THE 1984 HEAVY-DUTY ENGINE CRANKCASE EMISSION REQUIREMENT AND MODIFICATION OF THE ENGINE LABELING REQUIREMENTS FOR 1984 AND SUBSEQUENT MODEL HEAVY-DUTY ENGINES AND VEHICLES CERTIFIED TO MEET CALIFORNIA'S OPTIONAL EXHAUST EMISSIONS STANDARDS USING THE TRANSIENT CYCLE TEST PROCEDURES.

Agenda Item No.: 83-12-2

Public Hearing Date: August 25, 1983

Response Date: August 25, 1983

Issuing Authority: Air Resources Board

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report and Board Resolution No. 83-24 identified a maximum daily statewide HC, CO, NOx, and particulate emissions increase of 0.02 tons, 0.03 tons, 0.01 tons, and 0.04 tons, respectively. The increased emissions would only occur for the lifetime of the affected 1984 model year vehicles. There are no feasible alternatives or mitigation measures available to reduce the potential impact, and in all other respects, the adopted amendments will not have significant adverse environmental impacts.

Response: None

CERTIFIED: Daniel Holmes
Board Secretary

Date: 10-21-83

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 7, 1983

Subject : Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to environmental comments raised during the comment period.

ATTACHMENTS
83-14
83-15
83-16
83-21
83-22
[redacted]

RECEIVED BY
Office of the Secretary
DEC 0 6 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution 83-25

August 25, 1983

Agenda Item No. 83-12-4

WHEREAS, Sections 39600 and 39601 of the Health and Safety Code authorize the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, with limited exceptions, Sections 43150 et seq. of the Health and Safety Code require all new motor vehicles sold or acquired for use in this state by California residents or businesses to have been certified by the Board as meeting California emission standards;

WHEREAS, with limited exceptions, Sections 27156 and 38001 et seq. of the Vehicle Code require all motor vehicles to be equipped with the air pollution control devices, in proper operating condition, which are required to meet applicable emission standards and regulations;

WHEREAS, Section 4000.1(a) of the Vehicle Code requires all motor vehicles which are subject to Board regulations to meet emissions inspection requirements and present a certificate of compliance upon initial registration and upon transfer of ownership and registration;

WHEREAS, Section 4000.1(e) of the Vehicle Code authorizes the Board to exempt designated classes of motor vehicles from the requirements of Section 4000.1(a) of the Vehicle Code;

WHEREAS, in the past, all light-duty, medium-duty and heavy-duty diesel vehicles, and motorcycles have been exempted from the emissions inspection and certificate of compliance requirements of Vehicle Code Section 4000.1(a);

WHEREAS, the California Environmental Quality Act (CEQA) and Board regulations require that no project having potentially significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available which would substantially reduce or avoid such impacts;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code; and

WHEREAS, the Board finds that:

Exempting all diesel vehicles and all motorcycles from the requirement to obtain emissions inspections and certificates of compliance has resulted in new diesel vehicles, and new motorcycles entering California which are not certified to comply with California standards;

An increase in the importation of vehicles which are not certified to meet California standards may occur in the near future because California's emissions standards for new 1984 and subsequent model year diesel vehicles and motorcycles are more stringent than comparable federal standards;

Requiring new diesel vehicles and new motorcycles to be inspected and to obtain certificates of compliance, or in-lieu "Statements of Buyer and Seller" as authorized by Vehicle Code Section 24007, upon initial registration is technologically and economically feasible;

Requiring new diesel vehicles and new motorcycles to be inspected and to obtain certificates of compliance is expected to result in an air quality benefit by reducing emissions from the use of vehicles which do not conform to California standards and by enhancing sales and use of vehicles certified for use in California;

The Department of Motor Vehicles (the "DMV") and the Bureau of Automotive Repair (the "BAR"), are the two government entities primarily responsible for implementing an inspection and certificate of compliance program for initial registration of new diesel vehicles and new motorcycles and the DMV and the BAR will need adequate lead time, through August 31, 1984, to develop and commence such a program;

At the present time, requiring emission inspections for used light-duty, medium-duty and heavy-duty diesel vehicles, and used motorcycles is not feasible, but an inspection program for used diesel vehicles and used motorcycles may become feasible in the near future;

The proposed amendments to Title 13, California Administrative Code, Sections 2160 and 2161 and proposed new Section 2162, would exempt all light-duty, medium-duty and heavy-duty diesel vehicles, and all motorcycles from the requirement to obtain emission inspections and certificates of compliance through August 31, 1984 only;

The proposed new regulations, Sections 2163, 2164 and 2165, would require certificates of compliance, or in-lieu "Statements of Buyer and Seller" as authorized by Vehicle Code Section 24007, for the initial registration of new, light-duty, medium-duty and heavy-duty diesel vehicles, and new motorcycles commencing September 1, 1984,

and would continue to exempt used diesel vehicles and used motorcycles from emission inspections and certificate of compliance requirements upon transfer of ownership and registration;

The proposed regulatory changes to extend for one year for new diesel vehicles and new motorcycles the existing exemption from inspections and certificates of compliance may result in a potential adverse air quality impact in that new vehicles with emissions in excess of California standards may be illegally sold or acquired for use in this state before the BAR and DMV inspection and compliance program includes these vehicles;

The potential adverse air quality impacts of the proposed regulatory changes will be limited to the extent that illegal vehicles are subject to agency enforcement efforts and statutory penalties; and

There are no feasible alternatives or mitigation measures available to reduce any potential adverse air quality impacts for extending the exemption for one year and in all other respects the adoption of the proposed regulations and amendments will not result in potential adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby adopts the amendments to Title 13, California Administrative Code, Section 2160 and 2161, as set forth in Attachment A hereto.

BE IT FURTHER RESOLVED that the Board hereby adopts Title 13, California Administrative Code, Sections 2162 through 2165 inclusive, as set forth in Attachment B hereto.

BE IT FURTHER RESOLVED that the Board determines that the new regulations and the amendments adopted herein are in the aggregate at least as protective of public health and welfare as applicable federal standards and are consistent with Section 202(a) of the federal Clean Air Act.

I certify that the above is a true and correct copy of Resolution 83-25, as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

ATTACHMENT A

Amend Title 13, California Administrative Code, Sections 2160 and 2161, to read as follows:

2160. Certificates of Compliance Exemptions -- New and Used Diesel Vehicles over 6,000 Pounds Gross Weight Rating~~,-Heavy-Duty-Diesel-Vehicles.~~

~~Pursuant-to-the-authority-vested-in-the-State-Air-Resources-Board by-Subdivision-(b)-of-Section-4000.1-of-the-Vehicle-Code,~~ Certificates of Compliance are not required upon registration, ~~and~~ nor upon transfer of ownership and registration of diesel-powered vehicles of 6,001 pounds manufacturer's maximum gross vehicle weight rating and over. This section is effective ~~for-the-calendar-years-1973-through-1982~~ through August 31, 1984 only.

NOTE: Authority cited: Section 4000.1(e), Vehicle Code; Sections 39600 and 39601, Health and Safety Code. Reference: Section 4000.1(e), Vehicle Code~~,; Specific-reference:--Section-4000.1(e),-Vehicle-Code,~~ Sections 43150-43156, Health and Safety Code.

2161. Certificates of Compliance Exemptions -- ~~,-Light-Duty~~ New and Used Diesel Vehicles, 6,000 Pounds or Less Gross Weight Rating.

~~Pursuant-to-the-authority-vested-in-the-State-Air-Resources-Board by-Subdivision-(b)-of-Section-4000.1-of-the-Vehicle-Code,~~ Certificates of Compliance are not required upon registration, ~~and~~ nor upon transfer of ownership and registration of diesel-powered vehicles of 6,000 pounds or less manufacturer's maximum gross vehicle weight rating. This section is effective ~~through-calendar-year-1982~~ through August 31, 1984 only.

NOTE: Authority cited: Section 4000.1(e), Vehicle Code; Sections 39600 and 39601, Health and Safety Code. Reference: Section 4000.1(e), Vehicle Code~~,; Specific-reference:--Section-4000.1(e),-Vehicle-Code,~~ Sections 43150-43156, Health and Safety Code.

Adopt Title 13, California Administrative Code, Sections 2162, 2163, 2164, and 2165, to read as follows:

2162. Certificates of Compliance Exemptions -- New and Used Motorcycles.

Certificates of Compliance are not required upon initial registration, nor upon transfer of ownership and registration of motorcycles. This section is effective through August 31, 1984 only.

NOTE: Authority cited: Section 4000.1(e), Vehicle Code; Sections 39600 and 39601, Health and Safety Code. Reference: Section 4000.1(e), Vehicle Code; Sections 43150-43156, Health and Safety Code.

2163. Certificates of Compliance Exemptions for Used Motorcycles.

Certificates of Compliance are not required upon transfer of ownership and registration of motorcycles, nor upon initial registration of motorcycles with odometer readings of over 7,500 miles. This section shall become effective on September 1, 1984, and shall supersede the provisions of Section 2162 on that date.

NOTE: Authority Cited: Section 4000.1(e), Vehicle Code; Sections 39600 and 39601, Health and Safety Code. Reference: Section 4000.1(e), Vehicle Code; Sections 43150-43156, Health and Safety Code.

2164. Certificates of Compliance Exemptions for Used Diesel-Powered Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles.

Certificates of compliance are not required upon transfer of ownership and registration of diesel-powered passenger cars, light-duty trucks, and medium-duty vehicles, nor upon initial registration of

diesel-powered passenger cars, light-duty trucks, and medium-duty vehicles with odometer readings of over 7,500 miles. This section shall become effective on September 1, 1984, and shall supersede the provisions of Sections 2160 and 2161 on that date.

NOTE: Authority Cited: Section 4000.1(e), Vehicle Code; Sections 39600 and 39601, Health and Safety Code. Reference: Section 4000.1(e), Vehicle Code; Sections 43150-43156, Health and Safety Code.

2165. Certificates of Compliance Exemptions for Used Heavy-Duty Diesel Vehicles.

Certificates of compliance are not required upon transfer of ownership and registration of heavy-duty diesel vehicles, nor upon initial registration of heavy-duty diesel vehicles with an odometer reading of over 7,500 miles. This section shall become effective on September 1, 1984, and shall supersede the provisions of Sections 2160 and 2161 on that date.

NOTE: Authority Cited: Section 4000.1(e), Vehicle Code; Sections 39600 and 39601, Health and Safety Code. Reference: Section 4000.1(e), Vehicle Code; Sections 43150-43156, Health and Safety Code.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Amendments to Title 13, California Administrative Code, Sections 2160 and 2161, and Adoption of Title 13, California Administrative Code, Sections 2162-2165, Regarding Certificate of Compliance Requirements for Diesel-Powered Light-Duty, Medium-Duty, and Heavy-Duty Vehicles, and Motorcycles

Agenda Item No.: 83-12-4

Public Hearing Date: August 25, 1983

Response Date: August 25, 1983

Issuing Authority: Air Resources Board

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The extension for one year of the exemption from inspections and certificate of compliance requirements may result in a potential adverse air quality impact in that new vhicles not meeting California standards may continue to be illegally sold or acquired for use in this state.

Response: The potential adverse air quality impacts of the proposed regulatory changes will be limited to the extent that illegal vehicles are subject to agency enforcement efforts and statutory penalties. In addition, there are no feasible alternatives to extending the exemption for one year and in all other respects the proposed regulatory changes will not result in potential adverse environmental impacts.

CERTIFIED: Maxine Holmes
Board Secretary

Date: 01/03/84

State of California
AIR RESOURCES BOARD

Resolution 83-27
August 26, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1187-98 (R) entitled "Pollutant Transport Study: Bay Area to North Central Coast Air Basin", has been submitted jointly by the Bay Area Air Quality Management District, Monterey Bay Unified Air Pollution Control District and Lawrence Livermore National Laboratory to the Air Resources Board;

WHEREAS, the Research staff has reviewed and recommended this proposal for approval;

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1187-98 (R) entitled "Pollutant Transport Study: Bay Area to North Central Coast Air Basin", submitted jointly by the Bay Area Air Quality Management District, Monterey Bay Unified Air Pollution Control District and Lawrence Livermore National Laboratory for a total amount not to exceed $150,000; and

WHEREAS, THE Governor's Executive Order D-18-83 prohibits State agencies from awarding research contracts through October 31, 1983;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1187-98 (R) entitled "Pollutant Transport Study: Bay Area to North Central Coast Air Basin", submitted jointly by the Bay Area Air Quality Management District, Monterey Bay Unified Air Pollution Control District and Lawrence Livermore National Laboratory for a total amount not to exceed $150,000; and

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-18-83 on awarding contracts for research be granted, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein in an amount not to exceed $150,000.

I certify that the above is a true and correct copy of Resolution 83-27 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-12-6b2
DATE: August 26, 1983

ITEM: Research Proposal No. 1187-98 (R) entitled "Pollutant Transport Study: Bay Area to North Central Coast Air Basin".

RECOMMENDATION: Adopt Resolution 83-27 approving Research Proposal No. 1187-98 (R) for funding in an amount not to exceed $150,000. Approval is contingent upon receiving supplemental funding from another source(s) in the amount of $75,000. Allocations of funds will be $75,000 from FY 1983-84 budget and $75,000 from FY 1984-85 budget contingent upon the Governor's approval of the 1984-85 budget proposal.

SUMMARY: The ARB sponsored a tracer study during 1980 to quantify transport from the Bay Area Air Pollution Control District into the Monterey Bay Unified Air Pollution Control District. This study clearly demonstrated that ozone concentrations above the Federal Standard (12 pphm) in the North Central Coast Air Basin are generally observed only during conditions which allow transport from the San Francisco Bay Area.

This project would use the aerometric data base collected during the ARB field study to perform air quality modeling computer simulations of proposed control strategies for this region.

This study is needed to determine how transport affects ozone levels throughout the North Central Coast Air Basin and the Bay Area Air Quality Management District under varying 1987 control strategies such as hydrocarbon only and combinations of oxides of nitrogen and hydrocarbon controls. Results will be incorporated into the air quality attainment plans of both districts.

State of California
AIR RESOURCES BOARD

Resolution 83-28

September 22, 1983

Agenda Item No. 83-14-1

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Sections 43013 and 43101 of the Health and Safety Code authorize the Board to adopt vehicle emission standards in order to control air pollution caused by motor vehicles:

WHEREAS, Section 43104 of the Health and Safety Code directs the Board to adopt test procedures to determine whether new motor vehicles are in compliance with the emission standards adopted by the Board;

WHEREAS, Title 13, California Administrative Code, Section 1960.1 establishes 50,000-mile particulate exhaust emission standards for diesel-powered passenger cars, light-duty trucks, and medium-duty vehicles of 0.4 gram per mile (g/mi) for the 1985 model year, 0.2 g/mi for the 1986 through 1988 model years, and 0.08 g/mi for the 1989 and subsequent model years;

WHEREAS, Title 13, California Administrative Code, Section 1960.1(h) establishes and incorporates test procedures for determining compliance with the emission standards;

WHEREAS, the Board has recognized that some new or additional emission control technology may be needed by most 1986 model year diesel-powered passenger cars, light-duty trucks, and medium-duty vehicles to meet the 1986 0.2 g/mi particulate standard;

WHEREAS, the control technology presently being developed includes a trap oxidizer system which collects exhaust particulate and periodically or continually regenerates by oxidizing the trapped particulate;

WHEREAS, diesel-powered vehicle manufacturers have expressed concern that the current test procedure does not adequately account for emission increases which may occur during periodic regenerations but which, when weighted with non-regeneration emissions, may not exceed the emission standards;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project having significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of the Administrative Procedure Act (Government Code, Title 2, Division 3, Part 1, Chapter 3.5);

WHEREAS, the Board finds that:

Trap oxidizer systems will be used for some 1986 and later model year diesel-powered passenger cars, light-duty trucks, and medium-duty vehicles to achieve compliance with the applicable particulate emission standards;

The periodic regeneration of a trap during an emission test under the current procedure could cause hydrocarbon and particulate emissions to exceed the applicable standards, even though the weighted regeneration and non-regeneration emissions may not exceed the standards;

The current test procedure does not specifically require testing periodic regeneration and non-regeneration emissions in the certification process and weighting the emissions accordingly;

The amendments to the test procedures and to Title 13, California Administrative Code, Section 1960.1(h) approved herein provide for the testing and weighting of periodic regeneration and non-regeneration emissions, therefore assuring emission results which are representative of the vehicle's useful life emissions characteristics;

The amendments adopted herein will have no significant adverse environmental impact;

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves the amendments to Title 13, California Administrative Code, Section 1960.1(h) as set forth in Attachment A hereto.

BE IT FURTHER RESOLVED that the Board hereby approves the amendments to the "California Exhaust Emission Standards and Test Procedures for 1981 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" as set forth in Attachment B hereto.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to adopt the amendments set forth in Attachments A and B after making them available to the public for a period of 15 days, provided, however, that the Executive Officer shall consider such written comments as may be submitted during this period, and shall present the regulations to the Board for further consideration if he determines that this is warranted in light of the written comments received.

BE IT FURTHER RESOLVED that the Board finds that the regulations and test procedures as amended herein, individually and in the aggregate with other California motor vehicle emission regulations, are at least as protective of public health and welfare as comparable federal regulations and are consistent with Section 202(a) of the federal Clean Air Act.

I hereby certify that this is a true and correct copy of Resolution 83-28 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 27, 1983

Subject: Filing of Notice of Decisions of the Air Resources Board

From : Harold Holmes
Board Secretary
Air Resources Board

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to significant environmental comments raised during the comment period.

Attachments
Resolution 83-28
Resolution 83-30
Resolution 83-32

FILED AND POSTED BY
OFFICE OF THE SECRETARY
DEC 28 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Amendments to Title 13, California Administrative Code, Section 1960.1, and Incorporated Test Procedures, Regarding Technical Changes to the Test Procedure for Diesel-Powered Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles Equipped with Periodically Regenerating Trap Oxidizer Systems

Agenda Item No.: 83-14-1

Public Hearing Date: September 22, 1983

Response Date: October 31, 1983

Issuing Authority: Executive Officer

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no significant adverse environmental effects.

Response: N/A

CERTIFIED: _____
Executive Officer

Date: January 5, 1984

State of California
AIR RESOURCES BOARD

Resolution 83-29
October 27, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, a proposal to augment Contract Number A2-118-32 entitled "Quantitative Assessment of the Effects of Not Controlling Air Pollution in California" has been submitted by the Energy Resources Consultants, Inc., to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> An augmentation to Contract Number A2-118-32 entitled "Quantitative Assessment of the Effects of Not Controlling Air Pollution in California", submitted by the Energy Resources Consultants, Inc., for a total amount not to exceed $13,274;

WHEREAS, the Governor's Executive Order D-18-83 prohibits State agencies from awarding research contracts through October 31, 1983;

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> An augmentation to Contract Number A2-118-32 entitled "Quantitative Assessment of the Effects of Not Controlling Air Pollution in California", submitted by the Energy Resources Consultants, Inc., for a total amount not to exceed $13,274; and

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-18-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-18-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $13,274.

I certify that the above is a true and correct copy of Resolution 83-29 as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-15-4b (1)
DATE: October 27, 1983

ITEM: Proposal to augment Contract Number A2-118-32 entitled "Quantitative Assessment of the Effects of Not Controlling Air Pollution in California"

RECOMMENDATION: Adopt Resolution 83-29 approving Proposed Augmentation of Contract A2-118-32 for an amount not to exceed $13,274

SUMMARY: This proposal is a request for an augmentation of an ongoing study designed to assess the air quality effects and the specific economic costs that California would incur if air pollution controls were reduced or eliminated in 1979 or in 1987. Project work is well underway in the estimation of emission rates and ambient pollution levels in 1979 and 1987 with reduced or no air pollution controls. Project work is also underway to identify various types of air pollution-induced damage. A potentially important additional area of work has emerged after examination of data available on the cost of pollution-caused health effects. It has been determined that existing methods of evaluating the cost of illnesses caused by pollution are seriously limited and would give under-estimates of true health costs.

The purpose of this augmentation is to measure changes in behavior and expenditures from asthma attacks related to ozone exposure and to obtain data that will permit a more comprehensive estimate of the health costs of pollution.

Briefly, the added effort includes administering two questionnaires to a panel of 100 asthmatics living in the Los Angeles area. The questionnaires will assess changes in behavior, medical expenditures, willingness to pay (to avoid risk, pain and suffering) and work loss associated with asthma attacks related to ozone exposure. The panel of asthmatics to be used are currently participating in an epidemiological study of asthmatics being conducted for the Board by the UCLA School of Medicine.

The Research Screening Committee approved this project amendment, contingent upon the written approval of the UCLA researchers.

The U.S. Environmental Protection Agency has expressed interest in obtaining data from this project on the changes in behavior and expenditures related to asthma attacks resulting from ozone exposure and plans to supplement the project further. The EPA augmentation will increase project funding by another $36,000.

State of California
AIR RESOURCES BOARD

Resolution 83-30

November 17, 1983

Agenda Item No.: 83-17-1

WHEREAS, Health and Safety Code Sections 39600 and 39601 require the Air Resources Board (the "Board") to adopt rules and regulations and take all actions necessary for the proper execution of the powers and duties granted to and imposed upon the state board;

WHEREAS, Health and Safety Code Section 39606(b) requires the Board to adopt ambient air quality standards, as defined by Health and Safety Code Section 39014, for the protection of the public health, safety, and welfare, including but not limited to health, illness, irritation to the senses, aesthetic value, interference with visibility, and effects on the economy;

WHEREAS, Health and Safety Code Section 39606(b) provides that standards relating to health effects associated with exposure to air contaminants shall be based upon the recommendation of the state Department of Health Services;

WHEREAS, the current short-term (one-hour) statewide ambient air quality standard for sulfur dioxide (SO_2) of 0.5 parts per million (ppm), as set forth in Title 17, California Administrative Code, Section 70200, was intended to address potential odor nuisances near point sources and possible changes in lung function associated with exposure to ambient concentrations of SO_2;

WHEREAS, recently published scientific research findings from clinical and laboratory studies which tested the effects of SO_2 on persons with asthma demonstrated that these persons were more sensitive to exposure to ambient concentrations of SO_2 than were healthy subjects and that these sensitive persons were affected adversely by brief, five to ten minute exposures to SO_2 at concentrations as low as 0.4 to 0.5 ppm;

WHEREAS, the Board has received and considered a recommendation from the Department of Health Services, dated August 29, 1983, for a short-term standard of 0.25 ppm SO_2 averaged over a one hour measurement period;

WHEREAS, the Board has held a duly noticed public hearing at which it received and considered a substantial body of evidence, both written and oral, presented to it by staff, other scientists, industry representatives, and other members of the public relating to the proposed amendment of the standard;

WHEREAS, in consideration of the recommendation of the Department of Health Services and in consideration of the staff's additional analysis of the relevant data and studies, the staff presented for the Board's consideration two alternative proposals to replace the existing one-hour 0.5 ppm state ambient air quality standard for SO_2, which were (a) 0.40 ppm SO_2 averaged over 10 minutes, and (b) 0.25 ppm SO_2 averaged over one hour, with the standard to be expressed as allowing no exceedances under each alternative, and using the fluorescence method as the approved measurement method;

WHEREAS, the California Environmental Quality Act and Board regulations require that action not be taken as proposed if feasible mitigation measures or alternatives exist which would substantially reduce any significant adverse environmental effects of the proposed action; and

WHEREAS, the Board finds that:

Laboratory studies on human volunteer subjects with asthma have demonstrated that many asthmatics are far more sensitive than healthy, nonsensitive persons when exposed to SO_2;

Evidence gathered from air pollution episodes and other research studies indicates that in addition to asthmatics other groups, including children, older persons, and persons with respiratory illnesses or allergies, are generally more sensitive to air pollution than healthy, nonsensitive persons;

The principal effect caused by SO_2 in these studies was bronchoconstriction, which is often accompanied by other symptoms including wheezing and shortness of breath;

The level of bronchoconstriction experienced by an individual as a result of exposure to SO_2 depends upon several factors, including the person's degree of sensitivity, the concentration of SO_2 in the exposure, the person's breathing rate during exposure, and the route of exposure;

The present one-hour standard does not adequately reflect the effects of short-term SO_2 exposure episodes on the public's health in that clinically significant bronchoconstriction and chest symptoms have been observed in free-breathing asthmatic subjects exposed for five to ten minutes to concentrations as low as 0.4 to 0.5 ppm SO_2 in the air being inhaled during moderate to heavy exercise, and in that other studies show that asthmatics and sensitive individuals who breathe by mouth alone are expected to undergo a similar response during modest levels of exertion;

SO_2 levels which exceed 0.25 ppm averaged over one hour may occur in some instances, and may have occurred in one instance, as a result of the unforeseen breakdown, under rare and exceptional circumstances, of pollution control equipment at a single very large emissions source, or may possibly occur as a result of a localized adverse and extremely rare meteorological event that may be anticipated to occur only at intervals of many years.

Whenever ambient levels of SO_2 exceed 0.25 ppm averaged over one hour, whatever the cause of the exceedance, adverse health effects are anticipated to occur in susceptible segments of the exposed population;

Improvements in measurement technology have led to the development and widespread use of the fluorescence method to measure SO_2 continuously, automatically, and to minimize interference;

The short-term SO_2 standard of 0.25 ppm averaged over one hour recommended by the Department of Health Services is designed to protect against the adverse effects associated with exposures to SO_2 at levels of 0.4 ppm for five to ten minutes, and is an appropriate precautionary standard to protect the public health; and

The short-term SO_2 standard adopted by this resolution will have a beneficial effect on air quality and will have no adverse environmental impacts.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves the amendment of the regulations contained in Title 17, California Administrative Code, as set forth in Attachment A and directs the Executive Officer to adopt such amendments after making them available to the public for at least 15 days.

BE IT FURTHER RESOLVED that in determining what control strategies and measures are necessary to attain and maintain the one-hour SO_2 standard, local districts may, in consultation with the Air Resources Board, take into account whether an exceedance of the standard is caused by a rare and exceptional localized meteorological event that may be anticipated to occur only at intervals of many years or by a rare and exceptional breakdown of pollution control equipment, and districts shall not be required to adopt generally applicable control measures to address an exceedance which is caused by such exceptional circumstances.

BE IT FURTHER RESOLVED that the Board directs the staff to continue to follow the review of the national ambient air quality standards for sulfur oxides (SO_2) and to study new evidence as it is published concerning the effects of SO_2 on asthmatics and other sensitive groups in the population.

I hereby certify that the above is a true and correct copy of Resolution 83-30 as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Amendments to Section 70100(i) and 70200, Title 17, California Administrative Code, Regarding the Short-Term (One-Hour) State Ambient Air Quality Standard for Sulfur Dioxide and Measurement Method

Agenda Item Nos.: 83-15-3
83-17-1

Public Hearing Date: October 27, 1983
October 28, 1983
November 18, 1983

Response Date: December 7, 1983

Issuing Authority: Air Resources Board

Comment: No public comments were received identifying any significant environmental issues pertaining to this item. The staff report concluded that the proposed amendments would not result in significant adverse environmental impacts.

Response: N/A

CERTIFIED: _____
Board Secretary

Date: 7/27/84

Amend portion of table contained in Section 70200, Title 17, California Administrative Code, to read as follows:

70200. Table of Standards -- Applicable Statewide.

	Concentration and Methods*	Duration of Averaging Periods	Most Relevant Effects	Comments
Sulfur Dioxide (SO_2)	0.25 ppm** ~~conductimetric method~~ fluorescence method	1 hour	~~a. Approximate odor threshold~~ ~~b. Possible alteration in lung function.~~ a. Bronchoconstriction accompanied by symptons, which may include wheezing, shortness of breath and chest tightness, during exercise or physical activity in persons with asthma.	~~Alteration in lung function was found at this level in only one study. Other studies reported higher concentrations to cause this effect.~~ The standard is designed to protect against adverse effects from short-term (5-10 min.) peak exposures.
	0.05 ppm ~~conducti metric method~~ fluorescence method, with oxidant, (ozone) equal to or greater than the state standard, or with suspended particulate matter equal to or greater than the state 24-hour suspended particulate matter standard.	24 hours	a. Will help prevent respiratory disease in children b. Higher concentrations associated with excess mortality.	a. Further studies on co-carcinogenic role are necessary. b. Does not include effects on vegetation, ecosystems and materials. c. May not include a margin of safety.

* * *

NOTE: Authority cited: Sections 39600, 39601(a), and 39606(b), Health and Safety Code. Reference: Sections 39014, 39606(b), 39701, and 39703(g), Health and Safety Code.

(The remainder of the table is not affected by these changes and continues fully in effect.)

Public Hearing to Consider Amendments to Sections 70100(i) and 70200, Title 17, California Administrative Code, Regarding the Short-Term (One-Hour) State Ambient Air Quality Standard for Sulfur Dioxide and Measurement Method

Public Hearing Dates: October 27, 1983
November 18, 1983
Public Availability Date: November 22, 1983

On October 27 and on November 18, 1983, the Air Resources Board (the "Board") considered the adoption of proposed amendments to Sections 70100(i) and 70200, Title 17, California Administrative Code, regarding the short-term (one-hour) state ambient air quality standard for sulfur dioxide and measurement method. Attached is a copy of the Board's Resolution 83-30, approving the amendments. Appended to Resolution 83-30 is the approved language showing additions to the originally proposed language by double underline.

In approving these amendments, the Board directed the Executive Officer to adopt the regulations after making them available to the public for a period of at least 15 days.

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 27, 1983

Subject : Filing of Notice of Decisions of the Air Resources Board

Harold Holmes
Board Secretary
From : Air Resources Board

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to significant environmental comments raised during the comment period.

Attachments
Resolution 83-28
Resolution 83-30
Resolution 83-32

FILED AND POSTED BY
OFFICE OF THE SECRETARY
DEC 28 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Resolution No. 83-31

October 27, 1983

WHEREAS, Laurence S. Caretto has served with distinction as a member of the Air Resources Board from September 1978 through September 1983;

WHEREAS, as a professor of engineering and Chairman of the Mechanical and Chemical Engineering Department at California State University at Northridge, he has outstanding technical, scientific, and leadership abilities which he has dedicated to developing and implementing California's program to clean up the air;

WHEREAS, he has been willing to work long and hard to assist his fellow Board members in piercing through masses of information to understand complex technical issues;

WHEREAS, his acknowledged expertise in the field of automobile emissions has played an invaluable role in shaping California's motor vehicle pollution control program, which is recognized as pre-eminent in the world;

WHEREAS, his balanced judgment, sense of fairness and technical knowledge have helped the Board to address California's air quality issues in an innovative manner, especially through:

- o the development of strong control measures for motor vehicles as well as emission limitations for power plant NOx, stationary internal combustion engines, oil refinery equipment, architectural coatings, vapor recovery equipment, fuel content, and the adoption of stringent state ambient air quality standards, all in consideration of many factors, including certain rare oenological insights;

- o the adoption of regulations for unique Kern County air quality issues, as the masterful compromiser trusted and sought after by local officials, industry representatives, and Air Resources Board staff alike;

- o the initiation of a program to control toxic air contaminants;

- o the continuing quest for more complete information, undaunted by even such personal sacrifice as the requirement to shave Larry's well-established beard for an inspection of Outer Continental Shelf oil facilities;

WHEREAS, Larry is a pleasure to work with and his stamina, dedication, and unfailing good humor have fostered mutual respect and understanding among Air Resources Board staff, his colleagues at air pollution control districts, representatives of business interests, and the general public;

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board extends its deepest appreciation to Larry Caretto and expresses its thanks for his outstanding contribution to California's progress towards clean air.

State of California
AIR RESOURCES BOARD

Resolution 83-32

November 18, 1983

Agenda Item No. 83-17-2

WHEREAS, Sections 39600 and 39601 of the Health and Safety Code authorize the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, the Permit Reform Act of 1981, Government Code Section 15374 et seq., was adopted to reduce delays in the issuance of permits and other forms of state agency approval;

WHEREAS, Section 15375 of the Government Code defines a permit as any license, certificate, registration, permit or other authorization required by a state agency to engage in a particular activity or act;

WHEREAS, the Board issues various approvals that are subject to the requirements of the Permit Reform Act, under the definition of permits contained in Government Code Section 15375;

WHEREAS, Section 15376 of the Government Code requires all state agencies to establish by regulation their procedures for considering and issuing permits, and also requires agencies to state in regulation the median, minimum, and maximum times for processing permit applications based on the agency's experience during the last two years;

WHEREAS, the staff has drafted a proposed regulation pursuant to the requirements of the Permit Reform Act;

WHEREAS, the California Environmental Quality Act and Air Resources Board regulations require that an activity not be approved as proposed if there are feasible alternatives or mitigation measures which would significantly reduce any adverse environmental impacts identified;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code;

WHEREAS, the Board finds that:

> the establishment of deadlines and other procedures for considering and acting upon permit applications contained in the proposed regulation will provide for expeditious and efficient review and consideration of such applications;

the proposed regulation complies with the requirements of the Permit Reform Act;

the proposed regulation will have no adverse environmental impact.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves the adoption of Section 60030 into Title 17, California Administrative Code, as set forth in Attachment A and directs the Executive Officer to adopt the regulation after making it available to the public for at least 15 days.

I hereby certify that the above is a true and correct copy of Resolution 83-32 as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

ATTACHMENT A

PROPOSED

Adopt new Article 3, Subchapter 1, Title 17, California Administrative Code, Section 60030, to read as follows:

Article 3. Permit Procedures

60030. Permit Application Review and Processing.

(a) The procedures and time periods set forth in this subsection shall apply to all permit applications received by the board, except for those permit applications specified in subsection (b).

(1) Within 30 days of receipt of an application for a permit, as defined in Government Code Section 15375(a), the executive officer shall inform the applicant, in writing, either that the application is complete and accepted for filing or that the application is deficient and identify the specific information required to make the application complete.

(2) Within ~~30~~ 15 days of receipt of additional information provided in response to a determination by the executive officer that an application is deficient, the executive officer shall inform the applicant, in writing, either that the new information is sufficient to make the application complete and that the application is accepted for filing, or that the application is deficient and shall identify the specific information required to make the application complete.

(3) Within 90 days after an application is accepted for filing, the executive officer shall act to approve or to disapprove the application.

(b) For the categories listed below, permit applications shall be processed as provided in the procedures specified in subsection (a), in accordance with the following time periods:

Type of Permit	No. of days after receipt of application within which executive officer will inform the applicant either that the application is complete or that additional information is required	No. of days after receipt of additional information within which executive officer will determine whether the information submitted makes the application complete	No. of days after application is accepted for filing within which executive officer will act on the application
Emergency variance for lead in gasoline[1]	~~15~~ 5	~~15~~ 5	~~45~~ 10
Emergency variance for sulfur in gasoline or diesel[2]	~~15~~ 5	~~15~~ 5	~~45~~ 10
Waiver for lead in gasoline[3]	15	15	45
Approval of independent testers[4]	15	15	90[5]

1. Title 13, California Administrative Code, Section 2253.2
2. Title 13, California Administrative Code, Section 2252
3. Title 13, California Administrative Code, Section 2253.2
4. Title 17, California Administrative Code, Section 91207
5. This period applies to each test, as specified in Section 91201 of Title 17, California Administrative Code, for which approval is requested.

(c) The executive officer may, in the course of processing the application, request the applicant to clarify, amplify, correct, or otherwise supplement the information required for the application.

(d) The time periods in subsections (a) or (b) may be extended by the executive officer for good cause as provided by Government Code Section 15376.

(e) Based on the state board's experience in processing permits, from the receipt of the initial application to the final permit decision, during the two years immediately preceding the proposal of these regulations:

(1) the minimum time for processing a permit was 5 days;

(2) the maximum time for processing a permit was 567 days; and

(3) the estimated median time for processing a permit was 30 days.

NOTE: Authority cited: Sections 39600 and 39601, Health and Safety Code. Reference: Sections 15375 and 15376, Government Code.

Public Hearing to Consider Adoption of Section 60030, Title 17, California Administrative Code, Establishing Procedures for Considering and Issuing Permits Pursuant to the Permit Reform Act of 1981

Public Hearing Date: November 18, 1983
Public Availability Date: November 21, 1983

On November 18, 1983, the Air Resources Board (the "Board") proposed the adoption of Section 60030 to Title 17, California Administrative Code, establishing procedures for considering and issuing permits pursuant to the Permit Reform Act of 1981. Attached is a copy of the Board's Resolution 83-32, approving the addition. Appended to Resolution 83-32 is the approved language showing additions to the originally proposed language by underline and deletions by overstrikes.

In approving Section 60030, the Board directed the Executive Officer to adopt the regulation after making it available to the public for a period of at least 15 days.

State of California

Memorandum

To : Gordon Van Vleck
Secretary
Resources Agency

Date : December 27, 1983

Subject : Filing of Notice of Decisions of the Air Resources Board

From : Air Resources Board
Harold Holmes
Board Secretary

Pursuant to Title 17, Section 60007 (b), and in compliance with Air Resources Board certification under section 21080.5 of the Public Resources Code, the Air Resources Board hereby forwards for posting the attached notice of decision and response to significant environmental comments raised during the comment period.

Attachments
Resolution 83-28
Resolution 83-30
Resolution 83-32

FILED AND POSTED BY
OFFICE OF THE SECRETARY
DEC 28 1983
Resources Agency of California

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Adoption of Section 60030, Title 17, California Administrative Code, Establishing Procedures for Considering and Issuing Permits Pursuant to the Permit Reform Act of 1981

Agenda Item No.: 83-17-2

Public Hearing Date: November 17, 1983

Response date: December 5, 1983

Issuing Authority: Executive Officer

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no adverse environmental impacts and noted that the regulation neither requires nor authorizes any action affecting the environment.

Response: N/A

CERTIFIED: _____
Executive Officer

Date: Jan 31, 1984

State of California
AIR RESOURCES BOARD

Resolution 83-33

December 16, 1983

Agenda Item No.: 83-

WHEREAS, Health and Safety Code Section 39600 requires the Air Resources Board (the "Board") to do such acts as may be necessary for the proper execution of the powers and duties granted to, and imposed upon, the Board;

WHEREAS, Health and Safety Code Section 41980 declares the Legislature's intent to investigate the methods of ensuring that emissions from the incineration of hazardous wastes do not endanger public health and welfare, while determining what appropriate role incineration could play in reducing the landfilling of hazardous waste materials in California;

WHEREAS, Health and Safety Code Section 41981 requires the Board, in consultation with the California Department of Health Services and affected air pollution control districts, to complete a study, using all available data on the emissions from the incineration of toxic waste materials;

WHEREAS, pursuant to the provisions of Health and Safety Code Section 41981, the study has been completed and Board staff have prepared a draft report entitled "Air Pollution Impacts of Hazardous Waste Incineration: A California Perspective;"

WHEREAS, the Board held a duly noticed public meeting at which it received public comments and considered the draft study prepared and presented to it by staff; and

WHEREAS, the Board finds that the study thoroughly and accurately addresses issues related to emissions from incineration of toxic waste materials in accordance with the Legislature's direction.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board approves the study, "Air Pollution Impacts of Hazardous Waste Incineration: A California Perspective," and directs the Executive Officer to forward it to the Legislature in accordance with Section 41981 of the Health and Safety Code.

I certify that the above is a
true and correct copy of
Resolution 83-33, as adopted
by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

Resolution 85-35
December 16, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 002-1 entitled "The Evolution of Aerosol Loadings During Wintertime Stagnation Episodes in the Southern San Joaquin Valley" has been submitted by the California Institute of Technology to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Scientific Advisory Committee on Acid Deposition has reviewed and recommends for funding:

> Proposal Number 002-1 entitled "The Evolution of Aerosol Loadings During Wintertime Stagnation Episodes in the Southern San Joaquin Valley" submitted by the California Institute of Technology for a total amount not to exceed $53,000; and

WHEREAS, the Governor's Executive Order D-26-83 prohibits State agencies from awarding research contracts through January 31, 1984.

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Scientific Advisory Committee on Acid Deposition and approves the following:

> Proposal Number 002-1 entitled "The Evolution of Aerosol Loadings During Wintertime Stagnation Episodes in the Southern San Joaquin Valley" submitted by the California Institute of Technology for a total amount not to exceed $53,000.

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-26-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-26-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $53,000.

I certify that the above is a true and correct copy of Resolution 83-35as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-19-4b(1)
DATE: December 16, 1983

ITEM: Research Proposal No. 002-1 entitled "The Evolution of Aerosol Loadings During Wintertime Stagnation Episodes in the Southern San Joaquin Valley."

RECOMMENDATION: Adopt Resolution 85-35 approving Research Proposal No. 002-1 for funding in an amount not to exceed $53,000. The total amount requested for this research is $105,762. Additional funding in the amount of $52,762 is being sought from the U.S. Evironmental Protection Agency.

SUMMARY: A large number of sources in the Southern San Joaquin Valley emit sulfur oxides and nitrogen oxides into the atmosphere. Under stagnant, humid conditions these pollutants can be transformed into acid gases and particles, including acidic fogs. These reaction products, either alone or combined with sources of particulate matter and ammonia in the valley, can contribute to the formation and persistence of dense haze and fogs which can severely restrict visibility and may affect human health.

Because the phenomenon of acid fog has only recently been identified, our understanding of the mechanisms of its formation, dispersion and dissipation are extremely limited. The Southern San Joaquin Valley represents a nearly ideal "laboratory" for the kind of study that is required to elucidate these and other processes.

In this study aerosol and fogwater samples will be collected and analyzed for chemical composition. Relatively small amounts of an inert, chemical tracer gas (sulfur hexafluoride) will also be released to determine transport and dilution patterns in the valley. Data from an extensive series of measurements will be analyzed to determine the retention time of pollutants released in the Valley and also the rate of formation of acids and their neutralization products in fog droplets.

The results of this research are needed to better understand the physical and chemical dynamics of aqueous aerosols and as a basis for future studies of the potential adverse health effects of acid fog. This improved understanding will help explain the formation of such fogs in areas of the State that are subject to both high acid precursor concentrations and foggy atmospheres.

State of California
AIR RESOURCES BOARD

Resolution 83-36
December 16, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1224-104 entitled "Effects of Short-term Exposure to Carbon Monoxide in Subjects with Coronary Artery Disease" has been submitted by the University of California, Irvine, to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1224-104 entitled "Effects of Short-term Exposure to Carbon Monoxide in Subjects with Coronary Artery Disease" submitted by the University of California, Irvine, for a total amount not to exceed $51,008; and

WHEREAS, the Governor's Executive Order D-26-83 prohibits State agencies from awarding research contracts through January 31, 1984.

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1224-104 entitled "Effects of Short-term Exposure to Carbon Monoxide in Subjects with Coronary Artery Disease" submitted by the University of California, Irvine, for a total amount not to exceed $51,008.

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-26-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-26-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $51,008.

I certify that the above is a true and correct copy of Resolution 83-36 as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-19-4b(2)
DATE: December 16, 1983

ITEM: Research Proposal No. 1224-104 entitled "Effects of Short-term Exposure to Carbon Monoxide in Subjects with Coronary Artery Disease".

RECOMMENDATION: Adopt Resolution 83-36 approving Research Proposal No. 1224-104 for funding in an amount not to exceed $51,008.

SUMMARY: The State's carbon monoxide (CO) standards are based in part on a series of clinical studies carried out on angina patients. These patients experience chest pains when their heart muscles fail to receive adequate oxygen. Carbon monoxide acts competively to decrease the ability of the blood to carry oxygen to the heart and thus endangers the health of this group of heart disease patients. Carbon monoxide acts on the blood by binding strongly to hemoglobin to form carboxy-hemoglobin (COHb). Our current air quality standards are designed to prevent exercising angina patients from reaching levels of COHb in excess of two percent.

The validity of some of the most important health studies carried out with angina patients under EPA auspices has recently come under question. It is, therefore, essential to restudy quickly, but carefully, the most pivotal of these studies. This proposal would allow for such replication, employing angina patients whose COHb levels will be increased to two percent as well as at one other level. These levels would be attained while breathing air containing controlled amounts of CO during light exercise.

The basic protocol of the study will have design characteristics the same as in the previously reported studies that are in question. Where appropriate, some improved methodologies will be used. Approximately 30 volunteers who have stable angina are to be studied.

This project, along with another that is being funded by the EPA, will provide the Board with a reliable scientific basis for a re-examination of the State ambient air quality standards for carbon monoxide.

State of California
AIR RESOURCES BOARD

Resolution 83-37
December 16, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1225-104 entitled "Maintain and Operate California Air Resources Board Field Fumigation Facility for Experimental Use" has been submitted by the University of California, Riverside, to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1225-104 entitled "Maintain and Operate California Air Resources Board Field Fumigation Facility for Experimental Use" submitted by the University of California, Riverside, for a total amount not to exceed $49,994; and

WHEREAS, the Governor's Executive Order D-26-83 prohibits State agencies from awarding research contracts through January 31, 1984.

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1225-104 entitled "Maintain and Operate California Air Resources Board Field Fumigation Facility for Experimental Use" submitted by the University of California, Riverside, for a total amount not to exceed $49,994.

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-26-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-26-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $49,994.

I certify that the above is a true and correct copy of Resolution 83-37 as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-19-4b(3)
DATE: December 16, 1983

ITEM: Research Proposal No. 1225-104 entitled "Maintain and Operate California Air Resources Board Field Fumigation Facility for Experimental Use".

RECOMMENDATION: Adopt Resolution 83-37 approving Research Proposal No. 1225-104 for funding in an amount not to exceed $49,994.

SUMMARY: Air pollution damage to the State's crop, native and ornamental plants is a continuing concern of the Air Resources Board. To address this concern, the ARB contracted with the proponent and the Statewide Air Pollution Research Center to construct, operate and maintain twenty plant fumigation chambers at U.C. Riverside during 1981. The proponent has constructed and operated an excellent facility for studying air pollution effects on plants since that time. It has been used continuously to study various agricultural crops and native plants.

Past experience has demonstrated the need for competent technical people to maintain and operate the chambers for investigators who may not be familiar with the complex aspects of fumigation systems and air pollutant monitoring. This proposal will continue operation and maintenance of the chamber facility for investigators during 1984, and will upgrade the facility by automating data accumulation and processing.

The proponent will refurbish the facility at the conclusion of each experiment, assure that all equipment performs satisfactorily, oversee use of the facility, and upgrade the facility by installing a small computer system to accumulate and process data automatically. Automatic accumulation of data will greatly reduce the amount of labor required for this task. Under current procedures data are transcribed from strip charts and processed by hand. Strip chart recorders will remain in use as a check in the event of a failure in the computer system. This proposal eliminates the need for the investigators who are plant scientists, to maintain the facility; rather it provides that the technical aspects of running the facility are performed by highly qualified personnel.

State of California
AIR RESOURCES BOARD

Resolution 83-38
December 16, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research proposal to augment Contract Number A2-088-32 entitled "Development of Methods to Estimate the Benefits of Visibility Improvement" has been submitted by the Santa Fe Research Corporation to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> An augmentation to Contract Number A2-088-32 entitled "Development of Methods to Estimate the Benefits of Visibility Improvement" submitted by the Santa Fe Research Corporation" for a total amount not to exceed $9,855; and

WHEREAS, the Governor's Executive Order D-26-83 prohibits State agencies from awarding research contracts through January 31, 1984.

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> An augmentation to Contract Number A2-088-32 entitled "Development of Methods to Estimate the Benefits of Visibility Improvement" submitted by the Santa Fe Research Corporation" for a total amount not to exceed $9,855.

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-26-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-26-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $9,855.

I certify that the above is a
true and correct copy of Resolution
83-38 as passed by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-19-4b(4)
DATE: December 16, 1983

ITEM: Proposal to augment Contract Number A2-088-32 entitled "Development of Methods to Estimate the Benefits of Visibility Improvement".

RECOMMENDATION: Adopt Resolution 83-38 approving Proposed Augmentation of Contract A2-088-32 for an amount not to exceed $9,855.

SUMMARY: This proposal requests an augmentation of a study, now in progress, to develop a methodology for evaluating quantitatively the residential property value benefits of visibility improvements in two California air basins. In the ongoing study, the development of spatially detailed data sets containing visibility, housing prices and socio-economic data is complete for four Los Angeles area counties and five San Francisco area counties covering two time periods, 1973-74 and 1978-79. Also, work is well under way in the estimation of economic models relating visibility data and housing values (sale prices) using the above mentioned data sets.

The purpose of the proposed augmentation is to demonstrate the use, and particularly the applicability and limitations, of the developed methodology and also to provide quantitative benefit estimates for a candidate emission control measure.

Under the proposed augmentation, the emissions, air quality and visibility changes will be estimated for a possible future measure to reduce particulate emissions from heavy duty vehicles in California. The likely phasing-in period for the emissions and air quality changes will be incorporated in the analysis. Using models developed in the original contract, dollar benefits of the improved visibility will be derived. A written report will be prepared to explain the use of the benefit estimation methodology. It will also establish guidelines for future application of the methodology to other potential control measures.

State of California
AIR RESOURCES BOARD

Resolution 83-39
December 16, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1228-104 entitled "Correlative and Sensitive Discriminants for Air Quality Control" has been submitted by the Professional Staff Association of Los Angeles County/USC Medical Center to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1228-104 entitled "Correlative and Sensitive Discriminants for Air Quality Control" submitted by the Professional Staff Association of Los Angeles County/USC Medical Center for a total amount not to exceed $123,000; and

WHEREAS, the Governor's Executive Order D-26-83 prohibits State agencies from awarding research contracts through January 31, 1984.

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1228-104 entitled "Correlative and Sensitive Discriminants for Air Quality Control" submitted by the Professional Staff Association of Los Angeles County/USC Medical Center for a total amount not to exceed $123,000.

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-26-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-26-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $123,000.

I certify that the above is a
true and correct copy of Resolution 83-39
as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-19-4b(5)
DATE: December 16, 1983

ITEM: Research Proposal No. 1228-104 entitled "Correlative and Sensitive Discriminants for Air Quality Control".

RECOMMENDATION: Adopt Resolution 83-39 approving Research Proposal No. 1228-104 for funding in an amount not to exceed $123,000.

SUMMARY: One of the most difficult questions facing the Board is the development of bases for ambient air quality standards that will protect against the chronic effects of exposure to air pollutants. The results of the studies proposed here will add significantly to our understanding of the human health consequences of long-term exposure to photochemical smog.

Two types of cells line the alveoli of the deep lung. The most common cell of the alveolar wall is the Type I cell. It is a very thin cell whose role is the efficent exchange of gases between the atmosphere in the lung and the blood. The Type II cell is distinquished by its thickness and appears to play a role in the lung defenses, including production of secretions. Previous work under ARB sponsorship has led to the development of methods to detect whether NO_2 or O_3 alone or the two in combination affect the rates of conversion of Type I cells to Type II and whether such changes are reversible.

These studies have shown that Type II cell populations increase at the expense of Type I cells, even at relatively low concentrations of NO_2 (0.3 ppm). Consistent changes have also been seen in alveolar walls in exposed animals. Such cellular level changes are thought to be the possible initiators of several irreversible diseases, including emphysema and fibrosis of the lung.

The primary purpose of this proposal is to study how the lung's structural components are changed by NO_2 exposure. It is closely related to the earlier work by the proponent, but differs in that the elastin and collagen to be measured in lung tissue are important indicators of permanent structural alterations of the lung. Attempts will be made to relate shifts in cellular-level components to changes in the amounts of these two proteins.

Staining techniques have been developed that specifically identify and differentiate elastin and collagen in lung sections. These specific stains will make it possible for the proponents to expand computer-assisted image analysis

methodologies that have proven very useful in previous studies. These methods allow the assessment of very large numbers of microscopic changes in lung structure. Subtle shifts can then be readily detected and recorded for analysis.

The exposure study planned will assess the effects of ambient level NO_2 on the lungs of developing mice. The experiment will employ 200 pairs of test animals, half to be exposed to the NO_2 atmosphere, half to serve as controls. The NO_2 exposure atmosphere will be 0.25 ppm presented in an intermittent fashion over a six week period. Animals will be removed from the control and exposed groups at the end of the exposure, ten weeks and six months after the exposure has ceased. Animals removed at 10 weeks and 6 months will serve to evaluate repair or recovery processes that might occur during the 14 weeks after exposures have ceased.

State of California
AIR RESOURCES BOARD

Resolution 83-40
December 16, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research proposal to augment Contract Number A2-042-32 entitled "A Study of the Characteristics of Chemical Reaction Mechanisms for Photochemical Smog" has been submitted by the California Institute of Technology to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> An augmentation to Contract Number A2-042-32 entitled "A Study of the Characteristics of Chemical Reaction Mechanisms for Photochemical Smog" submitted by the California Institute of Technology for a total amount not to exceed $38,615; and

WHEREAS, the Governor's Executive Order D-26-83 prohibits State agencies from awarding research contracts through January 31, 1984.

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> An augmentation to Contract Number A2-042-32 entitled "A Study of the Characteristics of Chemical Reaction Mechanisms for Photochemical Smog" submitted by the California Institute of Technology for a total amount not to exceed $38,615.

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-26-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-26-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $38,615.

I certify that the above is a true and correct copy of Resolution 83-40 as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-19-4b(6)
DATE: December 16, 1983

ITEM: Proposal to augment Contract Number A2-042-32 entitled "A Study of the Characteristics of Chemical Reaction Mechanisms for Photochemical Smog."

RECOMMENDATION: Adopt Resolution 83-40 approving Proposed Augmentation of Contract A2-042-32 for an amount not to exceed $38,615.

SUMMARY: This is a two-phase project to improve the mathematical treatment of the photochemistry module of air quality simulation models. The first phase of the project consisted of two objectives that were to: 1) review and analyze the methodologies by which the many simultaneously occurring chemical reactions can be combined to facilitate their solution; and 2) development of an improved kinetic mechanism for aromatic hydrocarbons for use in existing models.

In the second phase of the project, which the Research Screening Committee endorsed following review of the final report for the first phase, the proponent will apply the information developed during the first phase of this contract to improve the photochemistry module of an existing air quality simulation model. The methodology developed in Phase I provides a powerful tool for identifying deficiencies in the photochemical modules in models and thus, provides information on how to reduce errors resulting from these deficiencies.

The first phase of the project was recommended for funding by the Research Screening Committee in 1982, with funding of the second phase of the project to be contingent upon its successful completion. At the November meeting, the Committee reviewed the results of Phase I and recommended that the Board approve the funding of Phase II, which provides for the use of the methodology developed in Phase I, to improve the predictive accuracy of an existing air quality simulation model.

Accurate air quality simulation models are potentially important to evaluation of various control strategies and air quality maintenance plans. However, all existing models contain serious flaws in their predictive capabilities. It is therefore, highly desireable to use this state-of-the-art methodology to provide a more accurate modeling capability.

State of California
AIR RESOURCES BOARD

Resolution 83-41
December 16, 1983

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code Sections 39700 through 39705;

WHEREAS, an unsolicited research Proposal Number 1227-104 entitled "Effects of Ozone on the Asthmatic Airway" has been submitted by the University of California, San Francisco, to the Air Resources Board; and

WHEREAS, the Research staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 1227-104 entitled "Effects of Ozone on the Asthmatic Airway" submitted by the University of California, San Francisco, for a total amount not to exceed $169,860; and

WHEREAS, the Governor's Executive Order D-26-83 prohibits State agencies from awarding research contracts through January 31, 1984.

NOW, THEREFORE, BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 1227-104 entitled "Effects of Ozone on the Asthmatic Airway" submitted by the University of California, San Francisco, for a total amount not to exceed $169,860.

BE IT FURTHER RESOLVED, that, should an exemption from the prohibition contained in Executive Order D-26-83 on awarding contracts for research be granted, or upon the expiration of Executive Order D-26-83, the Executive Officer is authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed in an amount not to exceed $169,860.

I certify that the above is a true and correct copy of Resolution 83-41 as passed by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

ITEM NO.: 83-19-4b(7)
DATE: December 16, 1983

ITEM: Research Proposal No. 1227-104 entitled "Effects of Ozone on the Asthmatic Airway".

RECOMMENDATION: Adopt Resolution 83-41 approving Research Proposal No. 1227-104 for funding in an amount not to exceed $169,860.

SUMMARY: Asthmatics are characterized by sensitive bronchoconstrictive responses and airway inflammation in response to injury. In this project, the contractor will examine the effect of ozone on the bronchial hyperreactivity of a well-characterized group of asthmatics. He will apply methods that he developed and successfully used in previous studies of asthmatics' response to sulfur dioxide, another lung irritant.

Three related investigations will be pursued. In the first, healthy asthmatic subjects will be screened and chosen for participation, based upon complete pulmonary function and bronchial reactivity tests. These subjects will be exposed to purified air in one test and 0.20-0.25 ppm ozone in another. Exposures will last for two hours. During this exposure the subjects will exercise for fifteen of each thirty minutes on a cycle ergometer at 300 kg-m/min (exertion equivalent to a brisk walk). Effects on bronchial reactivity will be measured directly by resistance change and also by a methacholine challenge on the eve of each study day and then following the experimental exposures.

In the second portion of the study, asthmatics will be recruited and exposed to ozone as previously described. Fiberoptic bronchoscopy will be performed before and after ozone exposure so that airway fluid can be collected. This fluid will be analyzed for the agents which cause inflammation and injury.

The third study will investigate the source of inflammation which occurs after ozone exposure. Dogs will be fed either a normal diet or one with an inhibitor called eicosapentaenoic acid. They will be exposed to ozone. Their periodic airway responsiveness, mucosal biopsy and fluid collection tests will be performed. These tests will aid in the identification of inflammatory agents. Finally, appropriate statistical tests will be used to analyze all data.

State of California
AIR RESOURCES BOARD

Resolution 83-42

December 16, 1983

Agenda Item No.: 83-19-2

WHEREAS, Health and Safety Code Section 39600 requires the Air Resources Board (the "Board") to do such acts as may be necessary for the proper execution of the powers and duties granted to, and imposed upon, the Board;

WHEREAS, the Legislature in 1982 enacted the Kapiloff Acid Deposition Act (Stats. 1982, ch. 1973; Health and Safety Code Sections 39900-39915) to address the problem of acid deposition in California;

WHEREAS, in Health and Safety Code 39901, the Legislature finds and declares that acid deposition resulting from other than natural sources is occurring in various regions of California and that this deposition may have significant adverse effects on the environment, on the economy and on public health;

WHEREAS, in Health and Safety Code Section 39902, the Legislature declares that the purpose of the Kapiloff Act is to establish a program to identify the sources of acid deposition, to determine its occurrence and environmental effects and to analyze the effectiveness and cost of emission control technologies and air quality management strategies, and, in Health and Safety Code Section 39903, makes the Board responsible for implementation of the Kapiloff Act;

WHEREAS, Health and Safety Code Section 39909 requires the Board, not later than January 1, 1984, and annually thereafter, with the advice and participation of the State Agency Working Group on Acid Deposition and the Scientific Advisory Committee on Acid Deposition created by the Kapiloff Act, to prepare and submit to the Governor and to the Legislature a report describing the activities and findings to date of the research and monitoring program, and identifying further actions required to control or mitigate acid deposition and its potential adverse effects;

WHEREAS, in accordance with the provisions of Health and Safety Code Section 39909, a draft report entitled "State of California Acid Deposition Research and Monitoring Program: Report to the Governor and the Legislature" has been prepared by the staff;

WHEREAS, the State Agency Working Group and the Scientific Advisory Committee have reviewed the draft report and have recommended changes and additions thereto;

WHEREAS, the Board has held a duly noticed public meeting at which it received comments on and considered the draft report prepared and presented to it by staff, along with the recommended changes and additions as assembled and presented by staff; and

WHEREAS, the Board finds that the report, after inclusion of the recommended changes and additions, thoroughly and accurately describes the activities, findings and plans of the acid deposition research and monitoring program.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board approves the report, "State of California Acid Deposition Research and Monitoring Program: Report to the Governor and the Legislature," along with the recommended changes and additions, and directs the Executive Officer to submit the report as approved to the Governor and the Legislature in accordance with Section 39909 of the Health and Safety Code.

I certify that the above is a true and correct copy of Resolution 83-42, as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

Resolution 83-43

December 15, 1983

Agenda Item No. 83-18-3

WHEREAS, Section 39601 of the Health and Safety Code authorizes the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Section 43100 of the Health and Safety Code authorizes the Board to certify new motor vehicles;

WHEREAS, Section 43102 of the Health and Safety Code, as amended in 1981 (stats. 1981, ch. 1185; AB 965), directs the Board to adopt certification and enforcement regulations which will allow a manufacturer to certify in California federally certified light-duty motor vehicles which are unavailable in this state provided that their emissions are offset by the manufacturer's California-certified vehicles whose emissions are below the applicable California standard;

WHEREAS, in 1982 the Board adopted "Guidelines for Certification of 1983 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California," (the "Guidelines") and adopted Section 1960.5 and amended Section 2061, Title 13, California Administrative Code, which incorporate the Guidelines, to implement AB 965 for the 1983 model year;

WHEREAS, following a July 28, 1983 hearing, the Board adopted amendments extending the original Guidelines through the 1987 model year;

WHEREAS, the Guidelines presently do not provide for offsetting of particulate emissions;

WHEREAS, the California and federal particulate emission standards for 1983 model year light-duty diesel-powered vehicles were identical, but the California particulate emission standard for 1985 model year light-duty diesel-powered vehicles is more stringent than the likely federal standard for the 1985 model year;

WHEREAS, following the Board's direction at the July 28, 1983 hearing, staff has prepared proposed amendments to the Guidelines and to Sections 1960.5 and 2061, Title 13, California Administrative Code, which would allow offsetting of particulate emissions for the 1985 model year with an 11 percent particulate emissions credit limit for diesel-powered passenger cars and a 45 percent particulate emissions credit limit for diesel-powered light-duty trucks;

WHEREAS, the California Environmental Quality Act (CEQA) and Board regulations require that no project having significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with Section 11340), Part 1, Division 3, Title 2 of the Government Code; and

WHEREAS, the Board finds that:

Adoption of the amendments proposed by staff providing for particulate emission offsets for the 1985 model year will allow adequate mitigation of model unavailability in 1985; and

Sale of otherwise unavailable federally certified diesel-powered light-duty vehicles pursuant to the amendments adopted herein will result in a slight adverse emissions impact; the measures contained in the Guidelines as amended herein mitigate the adverse emissions impact to the maximum extent currently feasible, and no additional mitigation measures or feasible alternatives which would eliminate or substantially further reduce any significant adverse environmental impact are currently available.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby amends Section 1960.5, Title 13, California Administrative Code, as set forth in Attachment A; Section 2061, Title 13, California Administrative Code, as set forth in Attachment B; and "Guidelines for Certification of 1983 through 1987 Model Year Federally Certified Light-duty Motor Vehicles for Sale in California", as set forth in Attachment C.

BE IT FURTHER RESOLVED that the Board finds that the regulations as amended herein, individually and in the aggregate with the other California motor vehicle emission regulations, are at least as protective of public health and welfare as comparable federal regulations and are consistent with Section 202(a) of the federal Clean Air Act.

BE IT FURTHER RESOLVED that, to the extent a waiver is necessary, the Executive Officer shall forward the adopted and amended regulations to the Environmental Protection Agency with a request for a waiver of federal preemption or for confirmation that they are within the scope of an existing waiver, pursuant to Section 209(b)(1) of the Clean Air Act.

I certify that the above is a true and correct copy of Resolution 83-43, as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

Amend Section 1960.5, Title 13, California Administrative Code, as follows:

1960.5. Certification of 1983 through 1987 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California.

(a) The exhaust emissions from new 1983 through 1987 model year federally certified passenger cars and light-duty trucks, subject to registration and sold and registered in this state pursuant to Section 43102(b) of the California Health and Safety Code, shall not exceed the applicable federal emissions standards as determined under applicable federal test procedures.

(b) With respect to any new vehicle required to comply with the standards set forth in paragraph (a), the manufacturer's written maintenance instructions for in-use vehicles shall not require scheduled maintenance more frequently than or beyond the scope of maintenance permitted under the test procedures referenced in paragraph (a). Any failure to perform scheduled maintenance shall not excuse an emissions violation unless the failure is related to or causes the violation.

(c) The standards and procedures for certifying in California 1983 through 1987 model year federally certified light-duty motor vehicles are set forth in "Guidelines for Certification of 1983 through 1987 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California", adopted July 20, 1982, as last amended ~~September 16, 1983~~ December 15, 1983.

NOTE: Authority cited: Sections 39601, 43100 and 43102, Health and Safety Code. Reference: Section 43102, Health and Safety Code.

Amend Section 2061, Title 13, California Administrative Code, as follows:

2061. Assembly-Line Test Procedures -- 1983 and Subsequent Model Years.

New 1983 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles subject to certification and manufactured for sale in California shall be tested in accordance with the "California Assembly-Line Test Procedures for 1983 and Subsequent Model Year Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles", adopted November 24, 1981, as amended May 25, 1983, including federally certified light-duty motor vehicles, except as provided in "Guidelines for Certification of 1983 through 1987 Model Year Federally Certified Light-Duty Motor Vehicles for Sale in California", adopted July 20, 1982, as last amended ~~September 16, 1983~~ December 15, 1983.

NOTE: Authority cited: Sections 39515, 39601, and 43210, Health and Safety Code. Reference: Sections 43102, 43105, 43210, 43211, and 43212, Health and Safety Code.

GUIDELINES FOR CERTIFICATION OF 1983 THROUGH 1987 MODEL YEAR FEDERALLY CERTIFIED LIGHT-DUTY MOTOR VEHICLES FOR SALE IN CALIFORNIA

I. APPLICABILITY

These guidelines adopted pursuant to Section 43102(b) of the California Health and Safety Code are applicable to 1983 through 1987 model year federally certified light-duty motor vehicles proposed for sale in California. These guidelines are not applicable to medium-duty trucks, motorcycles, heavy-duty engines, heavy-duty vehicles, emergency vehicles, or vehicles with engines having a displacement less than 50 cubic inches.

II. DEFINITIONS

For the purposes of these guidelines:

1. "Light-duty motor vehicle" means a vehicle having a manufacturer's maximum gross vehicle weight rating of under 6,001 pounds (California Health and Safety Code Section 39035).
2. "California vehicle" means a motor vehicle originally certified in California by an Executive Order.
3. "Equivalent inertia weight (EIW)" is defined under subparagraph 86.129-79(a), Title 40, Code of Federal Regulations.
4. "Federal vehicle" means a motor vehicle originally certified federally by a Certificate of Conformity.
5. "Model" means a unique combination of car line, basic engine, and transmission class, or as defined by a manufacturer with the approval of the Executive Officer.

6. "Car Line" means a name denoting a group of vehicles within a make or car division which has a degree of commonality in construction (e.g., body, chassis). Car line does not consider any level of decor or opulence and is not generally distinguished by characteristics as roof line, number of doors, seats, or windows, except for station wagons or light-duty trucks. Station wagons and light-duty trucks are considered to be different car lines than passenger cars.

7. "Basic Engine" means a unique combination of manufacturer, engine displacement, number of cylinders, fuel system (as distinguished by use of carburetor or fuel injection), and catalyst usage.

8. "Transmission Class" means a group of transmissions having the following common features: basic transmission type (manual, automatic, or semi-automatic), number of forward speeds (e.g., manual four-speed, three-speed automatic, two-speed semi-automatic).

III. CERTIFICATION OF FEDERAL VEHICLES

To receive certification for federal vehicle sales in California, a manufacturer shall:

A. Provide to the Executive Officer evidence of federal certification, and a statement that the model(s) for which certification is requested are not available in California.

B. Provide a warranty on emissions-related parts in accordance with Sections 2035 et seq., Title 13, California Administrative Code, as they apply to vehicles certified under the primary California standards. However, federal vehicles which are offset by California vehicles certified to a 100,000-mile optional standard shall provide a ten-year/ 100,000-mile warranty.

C. Provide: 1) certification emission levels of federal models intended for sale in California, 2) quarterly production reports, by model and engine family, of vehicles intended for sale or sold in California, and 3) other information which the Executive Officer deems necessary to calculate emissions offset credits, emission deficits, or air quality impacts.

D. Label each vehicle on the assembly-line with the statement "conforms to federal regulations and is certified for sale in California" to distinguish federal vehicles certified for sale in California from other federal and California vehicles.

IV. ASSEMBLY-LINE AND ENFORCEMENT TESTING

A. All federal vehicles certified and intended for sale in California shall comply with all provisions of the applicable California Assembly-Line Test Procedures, except that:

1. The Executive Officer, at his or her discretion, may accept quality audit emissions data from other sources in lieu of a 2 percent quality audit of federal vehicle production intended for sale in California.

2. Manufacturers which have projected sales of less than 1,000 federal vehicles per model year in California shall be exempt from the 2 percent quality audit requirement. However, such manufacturers shall submit to the Executive Officer any other similar data which may be available.

3. Data submitted in lieu of 2 percent quality audit data shall be accompanied either by a statement that the data were generated according to California Assembly-Line Test Procedures, or by a description of how the testing and analysis procedures used depart from California Assembly-Line Test Procedures.

4. The Executive Officer, at his or her discretion, may waive the requirement for 100 percent steady state emissions testing of federal vehicles intended for sale in California in cases where lack of test facilities or other factors would place undue burden on vehicle manufacturers.

B. All federal vehicles certified for sale in California shall be subject to the compliance testing requirements of Title 13, California Administrative Code.

V. OFFSETTING PROCEDURE

A. Emissions offsetting shall be limited as follows:

1. By manufacturer. A manufacturer shall not trade, sell, transfer, or in any other manner exchange emissions credits with another manufacturer, except that a

manufacturer which supplies engines to a vehicle manufacturer may also supply offsetting emission credits if the vehicle manufacturer's total production for California is less than 200 units per model year.

2. By vehicle category. Vehicle categories are: (a) passenger cars and (b) light-duty trucks (less than 6,001 pounds gross vehicle weight rating). Emission credits from vehicles in one category shall not offset vehicles in the other category.

3. By fuel type. Offsetting shall be conducted only among vehicles with like fuels (e.g., gasoline to gasoline, diesel to diesel, etc.).

4. By durability option. Federal vehicles which are offset by California vehicles certified to the optional 100,000-mile emissions standards must demonstrate 100,000-mile durability, or the equivalent, subject to the approval of the Executive Officer.

5. By model. No federally certified vehicle shall be certified or sold in California if a comparable California model of the same manufacturer is offered in the same model year.

6. By pollutant. Oxides of nitrogen (NOx) and particulates are ~~is~~ the only pollutants which may be offset for passenger cars. Hydrocarbons, carbon monoxide, ~~and~~ NOx, and particulates may be offset for light-duty trucks. Particulates may be offset for passenger cars and light-duty trucks only for the 1985 model year.

Evaporative hydrocarbons ~~and particulates~~ are not eligible for offsets. Total hydrocarbon data shall be compared directly to non-methane hydrocarbon data for purposes of calculating offsets.

B. Each manufacturer shall submit to the Executive Officer by October 1 of each year, or as soon thereafter as is practicable: (1) an estimate of the emissions credits which it will accrue based upon California certified emissions levels and projected sales of California vehicles; and (2) an estimate of the emissions credits which it will use based upon federal certification emissions levels and estimated sales of federal vehicles in California. These estimates may be changed at any time within the model year, subject to the approval of the Executive Officer.

C. Within the bounds of Part A, emissions credits that can be accrued by a California certified vehicle shall be the difference between the applicable California standard and the certification emissions level.

$$\text{Estimated Credits} = \sum_{i=1}^{m} \text{Calsales}_i \, (\text{Calstd} - \text{Calcert}_i)$$

Where:

m = Number of California engine families certified to a set of California standards (passenger cars, 0-3999 pounds EIW trucks, 4000-5999 pounds EIW trucks) for a given manufacturer.

Calsales = Manufacturer's projected sales by engine family.

Calstd = Applicable California standard.

Calcert = California engine family certification level listed on the Executive Order for the applicable engine family.

D. Within the bounds of Part A, the emissions required to offset a federal vehicle shall be the difference between the federal certification level and the sales-weighted mean certification level of all California engine families (Calmean) as of February 1 of the previous model year for passenger cars or the appropriate light-duty truck group as applicable. If a new standard is implemented, an estimated Calmean shall be determined at 80 percent of the new standard. The estimated Calmean shall be applicable, for the initial model year under the new standard only.

$$\text{Estimated Withdrawals} = \sum_{j=1}^{n} \text{Fedsales}_j \, (\text{Fedcert}_j - \text{Calmean})$$

Where:

n = Number of unavailable passenger car and light-duty trucks by model types.

Fedsales = Estimated sales of unavailable federal model types in California for a given model year.

Fedcert = Federal certification level of the engine family containing the unavailable model. Federal certification level shall be taken as the highest level, for each pollutant, of any emission data vehicle in an engine family.

Calmean = Sales weighted mean certification emission level of all California engine families (industry-wide) within the appropriate standards category.

E. The estimates referred to in Parts B, C, and D shall be corrected at year-end using vehicle production and assembly-line emissions data, if available.

F. For the purposes of withdrawals, the 0 to 3,999 lbs. and 4,000 to 5,999 lbs. EIW groups may be combined for light-duty trucks.

G. Manufacturers shall individually be limited to withdrawing the following percentages of accrued credits for offsetting federal vehicles:

Passenger Car NOx	-	8%	
Passenger Car Particulate	-	11%	(1985 model year only)
Light-Duty Truck HC	-	74%	
Light-Duty Truck CO	-	17%	
Light-Duty Truck NOx	-	39%	
Light-Duty Truck Particulate	-	45%	(1985 model year only)

H. An emission deficit caused by misjudging sales of California vehicles shall be offset in the next model year.

I. Sales of federal vehicles in excess of a manufacturer's final estimate shall cause the manufacturer to be subject to a maximum civil penalty of $5,000 per vehicle pursuant to Section 43154 of the Health and Safety Code, regardless of whether or not a deficit was incurred.

J. Vehicles with engine family certification emission levels which are equal to or less than the appropriate "Calmean" value are not eligible for offsetting.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Amendments to Sections 1960.5 and 2061, Title 13, California Administrative Code, and Amendment of the Document Incorporated in those Sections, Regarding Trading of Particulate Emissions for Certification of Federally Certified Light-Duty Motor Vehicles for Sale in California

Agenda Item No.: 83-18-3

Public Hearing Date: December 15, 1983

Response Date: December 15, 1983

Issuing Authority: Air Resources Board

Comment: The staff identified a slight potential increase in particulate emissions of 0.04 tons per day resulting from the proposed action.

Response: To the extent that the potential increase in particulate emissions may be determined to be a significant adverse emissions impact, the proposed action incorporates all feasible mitigation measures. These mitigation measures include permitting offsets only between California and federal in the same category, (e.g., passenger car and truck) produced by the same manufacturer and using the same fuel (gasoline or diesel); basing offset credits on the difference between federal certification levels of the federal vehicles and the mean emission level of the California fleet in the same category or group; limiting use of diesel particulate credits to 11 percent by passenger cars and 45 percent for light-duty trucks; requiring California warranties; and making the federal vehicles subject to the state quality audit and enforcement regulations. No additional mitigation measures or feasible alternatives which would eliminate or substantially further reduce any significant adverse environmental impact are currently available.

CERTIFIED: Harold Holmes E.S.
Board Secretary

Date: August 28, 1984

State of California
AIR RESOURCES BOARD

Resolution 83-44

December 15, 1983

Agenda Item No.:83-18-2

WHEREAS, Sections 39600 and 39601 of the Health and Safety Code authorize the Air Resources Board (the "Board") to adopt standards, rules, and regulations necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Sections 43004, 43006, and 43013 of the Health and Safety Code authorize the Board to adopt standards and test procedures for vehicles modified or altered to use a gaseous fuel which are equivalent to those for gasoline powered motor vehicles;

WHEREAS, the Board has established in regulation, at Section 2030, Title 13, California Administrative Code, standards and test procedures for approval of systems designed to convert motor vehicles to use liquefied petroleum gas or natural gas fuels;

WHEREAS, the Board has adopted exhaust emission standards for passenger cars, light-duty trucks, and medium-duty vehicles, as set forth in Sections 1960.1 et seq., Title 13, California Administrative Code, and for heavy-duty engines and vehicles as set forth in Sections 1956.5 et seq., Title 13, California Administrative Code;

WHEREAS, the staff has prepared draft amendments to the "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles to Use Liquefied Petroleum Gas or Natural Gas Fuels", which were first adopted by the Board on April 16, 1975, and last amended on April 18, 1981;

WHEREAS, the proposed amendments would conform the standards and test procedures for liquefied petroleum gas and natural gas conversion systems to the Board's current new vehicle and engine certification regulations, simplify the gaseous fuel conversion systems certification procedures, provide more flexibility for compliance with the procedures for meeting applicable emission standards, and reduce the amount of testing required for certification;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project having significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of the Administrative Procedure Act (Government Code, Title 2, Division 3, Part 1, Chapter 3.5);

WHEREAS, the Board finds that:

the proposed amendments to the Board's regulations are necessary in order to conform the emission standards for engines modified or altered to use liquefied petroleum gas or natural gas fuels pursuant to the provisions of Health and Safety Code Section 43004;

the technology needed to alter or modify such engines to comply with the new vehicle emission standards is feasible and available;

the proposed amendments will provide additional flexibility for manufacturers to comply with the procedures and reduce the amount of testing required for certification and, hence, the costs to some manufacturers for certification, while assuring that approved conversion systems will comply with applicable emission standards;

the proposed amendments to the Board's regulations will not result in potentially significant adverse impacts on the environment.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby approves the amendment to Section 2030 of Title 13, California Administrative Code, as set forth in Attachment A, and the amendments to the "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles to Use Liquefied Petroleum Gas or Natural Gas Fuels" as set forth in Attachment B.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to adopt the amended regulation and the amended test procedures after they have been made available to the public for at least 15 days.

BE IT FURTHER RESOLVED that the Board hereby determines that the regulatory amendments adopted herein are consistent with Section 202(a) of the Clean Air Act, and these amendments do not render California standards and regulations, individually or in the aggregate with other California motor vehicle emission regulations, less protective of public health and welfare than the comparable federal standards.

BE IT FURTHER RESOLVED that, to the extent a waiver is necessary, the Executive Officer shall forward the adopted and amended regulations to the Environmental Protection Agency with a request for a waiver of federal pre-emption or for confirmation that they are within the scope of an existing waiver, pursuant to Section 209(b)(1) of the Clean Air Act.

I certify that the above is a true and correct copy of Resolution 83-45, as adopted by the Air Resources Board.

Harold Holmes, Board Secretary

Public Hearing to Consider Amendments to Title 13, California Administrative Code, Section 2030, Regarding the Standards and Test Procedures for Approval of Systems Designed to Convert Motor Vehicles to Use Liquefied Petroleum Gas or Natural Gas Fuels

Public Hearing Date: December 15, 1983
Public Availability Date: July 31, 1984

On December 15, 1983, the Air Resources Board (the "Board") considered the adoption of proposed amendments to Section 2030, Title 13, California Administrative Code, regarding the "California Exhaust Emission Standards and Test Procedures for Approval of Systems Designed to Convert Motor Vehicles to Use Liquefied Petroleum Gas or Natural Gas Fuels." Attached is a copy of the Board's Resolution 83-44, approving the amendments. Appended to Resolution 83-44 is the approved language showing additions to the originally proposed language by double underline and deletions by slashes.

In approving these amendments, the Board directed the Executive Officer to adopt the regulation and test procedures after making them available to the public for a period of at least 15 days.

ATTACHMENT A

Amend Title 13, California Administrative Code, Section 2030 to read as follows:

Liquefied Petroleum Gas and Natural Gas. The standards and test procedures for approval of systems designed to convert motor vehicles to use liquefied petroleum gas or natural gas fuels are contained in "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles to Use Liquefied Petroleum Gas or Natural Gas Fuels" adopted by the ~~State Board~~ state board on April 16, 1975, ~~and~~ as amended ~~on April 18, 1981~~ August , 1984.

Note: Authority cited: Section 39515, 39600, 39601, and 43006, Health and Safety Code. Reference: Sections 43000, 43004, 43006, 43013, ~~and~~ 43101, and 43104, Health and Safety Code.

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CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES TO USE LIQUEFIED PETROLEUM GAS OR NATURAL GAS FUELS

The authority for these Exhaust Emission Standards and Test Procedures is found in Sections 43004 and 43006 of the California Health and Safety Code which contain the following:

> 43004. "--the standards applicable under this part for exhaust emissions for gasoline-powered motor vehicles shall apply to motor vehicles which have been modified or altered to use a fuel other than gasoline or diesel."
>
> 43006. "The state board may certify the fuel system of any motor vehicle powered by a fuel other than gasoline or diesel which meets the standards specified by Section 43004 and adopt test procedures for such certification."

1. General Applicability

   This test procedure is applicable to any single or dual-fuel motor vehicle conversion system using liquefied petroleum gas (LPG) or natural gas (NG) in lieu of the original gasoline or diesel fuel system for emission controlled vehicles registered in the State of California.

2. Definitions

   The definitions shall be the same as those in the applicable model year California exhaust emission standards and test procedures for passenger cars, light-duty trucks, and medium-duty vehicles.

   All provisions of these procedures (except where specifically noted) shall apply to single fuel liquefied petroleum gas (LPG), single fuel natural gas (NG), and dual-fuel (LPG/gasoline or NG/gasoline) conversion systems.

3. General Standards

   (a) In addition to all other standards or requirements imposed, any modification of a gasoline or diesel-fueled motor vehicle to allow the use of liquefied petroleum gas or natural gas as a fuel:

      (i) Shall not in its operation or function cause the emission into the ambient air of any noxious or toxic substance that is not emitted in the operation of such vehicle without such modification, except as specifically permitted by regulation; and

(ii) Shall not in its operation, function, or malfunction, result in any unsafe condition endangering the motor vehicle, its occupants, other persons, or property in close proximity to the vehicle, in accordance with the safety requirements specified for the original vehicle.

(b) In the case of a dual-fuel conversion, where the vehicle may run on gasoline (or diesel) or a gaseous fuel, removal of originally required emission control systems will not be permitted. These provisions shall not apply to heated intake air systems~~.~~ or the original air cleaner when replaced by an air cleaner compatible with the LPG/NG carburetor.

4. Non-Applicable Regulations

All requirements in the referenced California exhaust emission standards and test procedures for gasoline or diesel-powered vehicles not directly related to exhaust emission test procedures shall not be applicable to these procedures.

~~5. Emission-Standards-and-Test-Procedures~~

~~(a) Passenger-Cars-and-Light-Duty-Trucks.~~

~~An-applicant-for-straight-LPG,-NG,-and/or-dual-fuel-conversion systems-may-choose-the-years,-makes-and-models-of-the-vehicles for-which-the-system-will-be-applicable.--The-test-vehicles shall-be-chosen-from-the-most-recent-year-vehicle-models,-and shall-be-designated-by-the-Executive-Officer.--The-applicant is-encouraged-to-propose-a-test-fleet-for-consideration-by-the Executive-Officer.~~

~~The-exhaust-emission-standards-to-be-used-for-approval-are-the applicable-California-emission-standards-or-typical-emission levels-of-vehicles-in-good-operating-condition-for-those passenger-cars-and-light-duty-trucks-selected-by-the-Executive Officer-as-test-vehicles.--Test-procedures-shall-be-the applicable-California-test-procedures-for-the-model-year-of the-test-vehicle.--Separate-approval-shall-be-required-for each-engine-size-class.--Back-to-back-tests-must-be-conducted and-a-significant-increase-in-emissions-from-the-baseline, even-if-the-vehicle-meets-the-applicable-model-year-standards, may-be-cause-for-denial.--In-addition,-for-dual-fuel-systems, the-Executive-Officer-may-require-CVS-72-or-CVS-75-tests-on gasoline-with-the-conversion-system.--The-durability-of-all systems-will-be-determined-by-an-engineering-evaluation.--For cause,-and-based-on-the-engineering-evaluation,-the-Executive Officer-may-require-durability-tests.~~

In-comparing-the-emission-figures,-test-variability-will-be taken-into-consideration.--The-allowable-variability-will-be based-on-the-previous-experience-of-the-testing-facility-and statistical-analysis-of-the-test-data.

(b) Heavy-Duty-Vehicles-(Single-and/or-Dual-Fuel-Systems)

1) Vehicles-over-6000-lbs.-(1977-or-older)

Approval-of-a-system-for-passenger-vehicles-shall automatically-qualify-that-system-for-use-on-1977-or older-model-vehicles-over-6000-lbs.-GVW-with-engines-in the-same-size-class-and-with-similar-emission-control systems.--If-no-passenger-vehicle-within-a-certain-engine class-is-available-for-test,-the-Executive-Officer-may permit-another-engine-class-or-a-previous-year-model-to be-tested.

2) Vehicles-Between-6,000-8500-lbs-(1978-or-newer,-Medium Duty-Vehicles)

These-vehicles-must-be-tested-in-accordance-with-the provisions-of-subparagraph-(a).

3) Vehicles-over-8500-lbs.-(1978-or-newer)

Approval-of-a-system-for-passenger-vehicles,-light-duty trucks,-or-medium-duty-vehicles-shall-automatically qualify-that-system-for-use-on-vehicles-over-8,500-lbs. GVW-with-engines-in-the-same-size-class-and-with-similar emission-control-systems-for-the-same-or-older-model years.--If-an-engine-in-a-certain-size-class-is-not available,-the-Executive-Officer-may-permit-the substitution-of-another-engine-in-a-different-class-or-a previous-model-year-engine.

In-the-alternative,-the-applicant-may-request-permission from-the-Executive-Officer-to-test-the-conversion-system on-an-engine-dynamometer.--A-detailed-description-of-the test-procedure-and-calculations-must-accompany-such-a request-and-must-be-approved-by-the-Executive-Officer prior-to-initial-tests.--Approval-by-this-method-shall only-apply-to-systems-when-used-on-heavy-duty-vehicles over-8,500-lbs.-GVW.--A-significant-increase-in-emissions from-the-baseline,-even-if-the-vehicle-meets-the applicable-heavy-duty-engine-emissions-standards,-may-be cause-for-denial.

~~(c) Dual-Fuel-Systems-(gasoline-and-LPG-or-NG)~~

~~In-addition-to-meeting-the-applicable-exhaust-emission standards,-the-vehicle's-exhaust-emissions-may-not-be significantly-increased-above-the-baseline-exhaust emissions-when-operating-on-gasoline-with-the-conversion system-installed.---Compliance-with-this-provision-may-be judged-by-the-hot-start-California-CVS-1972-test procedure,-or-the-applicable-cold-start-California CVS-1975-test-procedure-at-the-option-of-the-applicant.~~

~~(d) Crankcase-Emissions---None-permitted~~

~~(e) Fuel-Evaporative-Emissions~~

~~No-increase-above-the-gasoline-system-baseline-is permitted-for-dual-fuel-systems.~~

5. ~~6.~~ Application for Approval

(a) An application for approval of a modification to use LPG or NG fuel in a gasoline- or diesel-powered engine may be made by any engine, vehicle or conversion equipment manufacturer.

(b) An application shall be required for each model-year even though the exhaust emission standards for approval of new vehicles may be the same for consecutive model-years.

(c) The application shall be in writing, signed by an authorized representative of the manufacturer, and shall include the following:

(i) Identification and description of the vehicles in each vehicle category and engine displacement ranges for which approval is requested.

There are three vehicle categories.

a) Passenger Cars (PC)

b) Light-duty Trucks (LDT) and Medium-duty Vehicles (MDV)

c) Heavy-duty Vehicles (HDV) powered by Heavy-duty Engines (HDE).

(ii) A complete description and identification of the conversion system, including carburetor model number(s), carburetor configuration/calibration code(s), vaporizer/regulator model number(s), evidence of proper assembly of the fuel tank and fuel lines, and the necessary ~~of all~~ modifications ~~and additions~~ to the engine or vehicle.

~~(iii) A description of the laboratory equipment used and the exhaust emission tests performed to ascertain compliance with the General Standards.~~

~~(iv) Emission data on such vehicles and engines tested in accordance with the applicable exhaust emission test procedures and standards.~~

(iii) ~~(v)~~ A statement of recommended maintenance procedures, including initial installation and initial tuning, and equipment necessary to ensure that the vehicle and engine in operation conform to the regulations. If the procedures are not uniform, then the specific procedures for each different make and model shall be given. A description of the program for training of personnel for such maintenance and installation.

(iv) ~~(vi)~~ An agreement that upon the Executive Officer's request any one or more of the test vehicles will be supplied to the Air Resources Board (ARB) for such testing as it may require, or (by mutual consent between the ARB and applicant) will be made available at the manufacturer's facility for such testing. Provided, that in the latter case, it is further agreed that the instrumentation and equipment specified by the ARB will be made available for testing operations. Any testing conducted at a manufacturer's facility pursuant to this subparagraph will be scheduled as promptly as possible.

(v) ~~(vii)~~ An agreement that up to two test vehicles per vehicle category ~~a reasonable number of vehicles~~ will be made available to the ARB for testing for such reasonable periods as may be required. These vehicles shall be selected from time to time by the Executive Officer and shall be typical of production models available for sale to the public. They shall also be representative of the engines and transmissions offered by the vehicle manufacturers.

(vi) ~~(viii)~~ An agreement that the modifications made in the field will be properly identified. To meet this requirement, the model number shall be permanently marked on the carburetor. A permanent label, to be affixed in the engine compartment where it may be easily read, covering the following for the specific installation shall be furnished. ~~for installation on the air cleaner or any other area where it may be easily read.~~ The label shall set forth the following:

1. Manufacturer's name and address.
2. ~~Approved by~~ The California Air Resources Board certification number identified as "CARB E.O. No. B-XX". ~~for use on ------ model year vehicles with engine sizes ------ in.^{3} to ------ in.^{3}.~~
3. Spark timing.
4. Idle speed.
5. Mixture adjustment (if used) including idle, cruise, and/or full throttle together with the method.
6. Diagrams for vacuum hose routing and electrical wiring harness.

~~6. Type of fuel (LPG, NG, or dual fuel).~~
~~7. Date of installation.~~
7. ~~8.~~ Carburetor, ~~Model No.~~ vaporizer/regulator model numbers, and carburetor configuration /calibration codes.
~~9. Vaporizer Model No.~~
~~10. A statement "For vehicles over 8500 lbs. GVW only", if applicable.~~
~~11. A list of non applicable systems (e.g.: Fuel injection, 3 way catalyst, etc.) if space permits.~~

~~(ix) For dual fuel systems, a description of any changes to the Original Equipment Manufacturer's the evaporative emission control system.~~

(d) An application may be made for certification to emission standards or to typical baseline emission levels.

6. Emission Standards and Test Procedures for PC, LDT, MDV, and HDE

(a) For certification to emission standards, the appropriate model-year exhaust emission standards to be used are the applicable California new vehicle exhaust emission standards. Test procedures shall be the applicable California new vehicle certification test procedures for the model-year of the test vehicle. Compliance is demonstrated by applying a deterioration factor ~~(DF)~~ to both the cold and hot start emission test results to project the emission levels to the end of the vehicle's useful life and comparing the results with the emission standards. ~~This~~ These test results must meet the applicable emission standards. A retest is permitted if the vehicle fails the first test. The assigned ~~DF~~ deterioration factor will be based on gasoline-powered or diesel-powered vehicle certification deterioration rates as specified by the Executive Officer. In addition, dual-fuel systems will require CVS-75 tests using the original fuel with the conversion system installed. This test result (with the certification ~~DF~~ deterioration factor or, if not available, an assigned ~~DF~~ deterioration factor applied) must also meet the applicable emissions standards.

(b) For certification to typical baseline emission levels, the exhaust emission levels to be used are those from representative vehicles in good operating condition selected by the Executive Officer for testing. Test procedures shall be the applicable California test procedures for the model-year of the vehicle. Back-to-back tests must be conducted and a significant increase in the ~~average~~ emissions from the baseline may be cause for denial. In order to improve data reliability, the manufacturer may elect to perform two back-to-back tests, in which case a significant increase in the average emissions of the two conversion system tests over the average baseline test emissions may be cause for denial. Test variability will be considered in establishing significant increases in ~~averaged~~ emissions. In addition, for dual-fuel systems, a CVS-~~7~~ 72 test~~s~~ using the original fuel ~~with the conversion system are~~ required. This test shall also not significantly increase emissions from the baseline level.

The test variability factors applicable for back-to-back tests are 1.10 for HC and NOx and 1.15 for CO emissions. The conversion system meets the compliance requirements when the emission data from the tests with the conversion system installed, are at or below the emission levels of the baseline emissions with the variability factors applied.

(c) For certification of conversion systems to be installed only on heavy-duty engines, the appropriate model-year exhaust emission standards and applicable (diesel or gasoline) exhaust emission test procedures shall be used. However, approval of a conversion system to be installed on PC or LDT/MDV shall automatically qualify the system for use with heavy-duty engines with similar or less sophisticated emission control systems witnout additional testing.

(d) The durability of all systems will be determined by an engineering evaluation. For cause, and based on the engineering evaluation, the Executive Officer may require durability tests.

7. Selection of Test Vehicles for the Limited Fleet.

A maximum of two test vehicles ~~will~~ may be required by the Executive Officer for each vehicle category ~~carburetor-model conversion-system~~. One test vehicle can represent the worst case and the other the most popular vehicle for which the conversion system is applicable. The Air Resources Board will notify the applicant in writing of the vehicles which can be used to demonstrate compliance. In requesting emission tests, the Air Resources Board will consider emission control system similarity over vehicle categories when determining the test fleet size.

~~If the applicant submits additional carburetor model conversion systems, one (but not both) of the previous test vehicles may be used. One vehicle shall represent the smallest engine size class for which approval is requested and the other the largest engine size class requested. The Executive Officer may, for cause, request up to two additional test vehicles for each carburetor model. The engine size classes are as follows:~~

~~Class A - 0 through 140 cubic inches~~
~~Class B - Over 140 through 200 cubic inches~~
~~Class C - Over 200 through 250 cubic inches~~
~~Class D - Over 250 through 300 cubic inches~~
~~Class E - Over 300 through 375 cubic inches~~
~~Class F - Over 375 cubic inches~~
~~Class G - Engines which cannot be classified because of unusual design.~~

~~If the application is for both light and medium duty vehicles, then a total of four test vehicles will be required for each carburetor model conversion system.~~

8. Vehicle Testing

To assure better test data utilization, each applicant shall obtain prior approval in writing from the Executive Officer on the test vehicle fleet. No research and development vehicles should be used in the certification fleet.

(a) Test Vehicles

(i) Vehicles Certifying to New Vehicle Exnaust Emission Standards.

Each test vehicle shall be a California certified version having been driven a minimum of 4,000 miles on gaseous fuel. The vehicle mileage accumulation must be done by driving the venicle on the road following a route of typical suburban type driving, or on a chassis dynamometer utilizing the Automobile Manufacturer's Association (AMA) mileage accumulation cycle. The applicant may request and the Executive Officer may allow test vehicles with less mileage if the applicant demonstrates emission stability. Emission stability can be demonstrated by performing two (2) consecutive CVS-75 emission tests with 500 miles of AMA type driving between tests and showing no change in emissions outside of test variability.

Each test venicle must also be subjected to a thorough examination prior to any emissions test(s) to detect and correct possible defects and deviations from manufacturer's specifications in emissions-related parts.

Testing may be performed at any independent laboratory properly equipped to conduct the tests. The test vehicles shall be under the control of the laboratory for the entire test period. Return of test vehicles to the applicant during the test period may invalidate the test results.

The laboratory's report must be submitted directly to the Executive Officer and contain all related information, including failed test data. Tests performed for research and development purposes before the application is submitted need not be reported. The applicant may not edit the laboratory report but may submit additional clarifying comments or information.

(ii) Vehicles Certifying to Typical Emission Levels

~~(a)~~ Each test vehicle shall be a California certified version having been driven a minimum of 4,000 miles on the original certification fuel as required for new vehicle certification. In the event that a manufacturer acquires a vehicle with less than 4,000 miles, the vehicle mileage must be brought to 4,000 miles by driving the vehicle on the road following a route of typical suburban type driving, or by accumulating mileage on a chassis dynamometer utilizing the ~~CVS-75 urban cycle~~ AMA mileage accumulation cycle. The Executive Officer may allow test vehicles with less mileage if the applicant demonstrates emission stability. Emission stability can be demonstrated by performing two (2) consecutive CVS-75 emission tests with 500 miles of AMA type driving between tests and showing no change in emissions outside of test variability.

Each test vehicle must also be subjected to a thorough examination prior to the baseline test to detect and correct possible defects and deviations from manufacturer's specification in emissions-related parts. The baseline emissions of the test vehicle should be typical for that particular make and model-year. Typical vehicle emissions will be determined by using the vehicle surveillance test data, supplemented by assembly-line test and certification test data as required and appropriate.

If a vehicle exceeds typical emission values, the applicant may make a full diagnostic evaluation of the vehicle, make any necessary repairs, and retest the vehicle. If no abnormal conditions of the engine or the emission controls are noted, the vehicle will be accepted as a test vehicle and its emissions data will be used for

comparison with conversion system test results. The applicant may forego the above and select another test vehicle from the given list of alternative vehicles.

Testing may be performed at any laboratory properly equipped to conduct the tests. The test vehicle shall be under the control of the laboratory for the entire test period. Return of the test vehicle to the applicant during the test period may invalidate prior test results.

After the baseline test has been run, prior approval must be obtained from the Executive Officer before any servicing, maintenance, or parts replacements are made, except those that are in accordance with the written instructions provided with the application. The same fuel shall be used for the back-to-back tests using gasoline or diesel. There should be sufficient fuel in the fuel tank to permit the baseline and with conversion system tests. The laboratory shall record all the above information and include it as part of the report. The laboratory's report must be submitted directly to the Executive Officer and contain all related information, including failed test data. Tests performed for research and development purposes before the application is submitted need not be reported. The applicant may not edit the laboratory report but may submit additional clarifying comments or information.

(b) Test Sequence

(i) Straight liquefied petroleum or natural gas conversions certifying to emission standards.

1. Adjust vehicle to vehicle manufacturer's specification.

~~2. Run Baseline Test (Cold start CVS-75).~~

2.~~3.~~ Install conversion system in accordance with conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

3.~~4.~~ Run one cold start CVS-75 test using gaseous fuel.

4. Run one cold start CVS-75 test using gaseous fuel (only if first CVS-75 test fails the emission standards).

(ii) Dual-fuel systems certifying to standards.

1. Adjust vehicle to vehicle manufacturer's specifications.

~~2. Run two baseline tests. One is a cold start CVS-75 and the other is a hot start CVS-72.~~

2.~~3.~~ Install conversion system in accordance with the conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

3. Run one cold start CVS-75 test using gaseous fuel.

4. Run one cold start CVS-75 test using gaseous fuel (only if first CVS-75 test on gaseous fuel fails the emission standards).

5. Run one ~~cold~~ hot start CVS-~~75~~ 72 test using gasoline or diesel fuel.

6. Run one ~~cold~~ hot start CVS-~~75~~ 72 test using gasoline or diesel fuel (only if first CVS-75 tests on gasoline or diesel fuel fails the emission standards).

~~4. Repeat cold start CVS-75 test using gaseous fuel and the hot start CVS-72 test using gasoline or diesel as the fuel.~~

~~5. As an alternative, the applicant may delete the two hot start CVS-72 tests and in their places run a cold start CVS-75 test with conversion system using gasoline or diesel fuel.~~

(iii) Straight liquefied petroleum or natural gas conversions certifying to typical baseline emission levels.

1. Adjust venicle to venicle manufacturer's specification.

2. Run ~~two~~ one cold start CVS-75 ~~tests~~ using gasoline or diesel fuel.

3. Install conversion system in accordance with conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

4. Run ~~two~~ one cold start CVS-75 test~~s~~ using gaseous fuel.

(iv) Dual-fuel systems certifying to typical baseline emission levels.

1. Adjust vehicle to vehicle manufacturer's specifications.

2. Run two ~~cold/start/CVS-75~~ baseline tests using gasoline or diesel fuel. One is a cold start CVS-75, and other is a hot start CVS-72.

3. Install conversion system in accordance with the conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

~~A/~~ ~~Run/two/cold/start/CVS-75/tests/using/gaseous/fuel~~

~~B/~~ ~~Run/two/cold/start/CVS-75/tests/using/gasoline/or diesel/fuel~~

~~4. Repeat cold start CVS-75 test using gaseous fuel and the hot start CVS-72 test using gasoline or diesel as the fuel.~~

~~5. As an alternative, the applicant may delete the two hot start CVS-72 tests and in their places run a cold start CVS-75 test with conversion system using gasoline or diesel fuel.~~

4. Repeat cold start CVS-75 test using gaseous fuel and the hot start CVS 72 test using gasoline or diesel as the fuel.

5. As an alternative, the applicant may delete the two hot start CVS 72 tests and in their places run a cold start CVS 75 test with conversion system using gasoline or diesel fuel.

~~Each vehicle tested for each carburetor (mixer) model must meet the requirements of this procedure.~~

~~9. Data to be Recorded:~~

~~Vehicle:~~

~~Make and Model~~
~~Vehicle Identification Number~~
~~Odometer Reading~~
~~Engine Displacement~~

~~Model year~~
~~License Number~~

~~Fuel System:~~

~~Nominal Fuel Tank Capacity:~~ ~~Gasoline or Diesel~~
~~LPG/NG~~

~~Fuel Tank Location~~
~~Model of Carburetor~~
~~Number of Carburetor Barrels~~
~~Model of Vaporizer and/or Regulator~~

~~Tuning Specifications:~~

~~Idle RPM~~
~~Ignition Timing~~
~~Carburetor Setting (Method used)~~
~~Other~~

~~Dynamometer Setting Specifications:~~

~~Inertia Loading~~
~~Curb Weight~~
~~Road Load Horsepower at 50 mph~~
~~Drive Wheel Tire Pressure~~

~~Note:~~ ~~All maintenance (repairs and/or adjustments) are to be recorded.~~

9. ~~10.~~ Calculation Procedures

The following calculation procedures are based on the Federal CVS-1975 Test Procedure. The final reported test results shall be computed by use of the following formulas:

Meaning of Symbols

PC - Passenger cars
LDT - Light-duty trucks
MDV - Medium-duty vehicles (over 6000-8500 lbs. GVW)
HDV - Heavy-duty vehicles (those venicles over 8500 lbs. GVW)

CO_{conc} = Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor, and CO_2 extraction, in ppm.

CO_{dm} = Carbon monoxide concentration of the dilution air sample as measured, in ppm.

CO_d = Carbon monoxide concentration of the dilution air corrected for water vapor extraction, in ppm.

CO_e = Carbon monoxide concentrations of the dilute exhaust sample volume corrected for water vapor and carbon dioxide extraction, in ppm. The calculation assumes the carbon to hydrogen ratio of the fuel to be 1:3.802 for natural gas and 1:2.656 for LPG

CO_{em} = Carbon monoxide concentration of the dilute exhaust sample as measured, in ppm.

CO_{mass} = Carbon monoxide emissions, in grams per test phase.

$CO_{2_{conc}}$ = Carbon dioxide concentration of the dilute exhaust sample corrected for background and water vapor, in percent.

CO_{2_e} = Carbon dioxide concentration of the dilute exhaust sample, in percent.

$CO_{2_{mass}}$ = Carbon dioxide emissions, in grams per test phase.

$Density_{CO}$ = Density of carbon monoxide is 32.97 g/ft^3 of 68°F and 760 mm. Hg pressure.

$Density_{CO_2}$ = Density of carbon dioxide is 51.85 grams per cubic foot at 68°F and 760 mm. Hg pressure.

$Density_{HC}$ = Density of hydrocarbons is 18.64 g/ft^3 for natural gas and 17.28 gms/ft^3 for LPG assuming an average carbon to hydrogen ratio of 1:3.802 for natural gas and 1:2.656 for LPG, at 68°F and 760 mm Hg pressure.

$Density_{NO_2}$ = Density of oxides of nitrogen is 54.16 g/ft^3 assuming they are in the form of nitrogen dioxide, at 68°F and 760 mm Hg pressure.

DF = Dilution Factor

H = Absolute humidity in grains of water per pound of dry air.

HC_{conc} = Hydrocarbon concentration for the dilute exhaust sample corrected for background, in ppm carbon equivalent, i.e., equivalent propane x 3.

HC_d = Hydrocarbon concentration of the dilution air as measured, in ppm carbon equivalent.

HC_e = Hydrocarbon concentration of the dilute exhaust sample, in ppm carbon equivalent.

HC_{mass} = Hydrocarbon emissions, in grams per test phase.

K_H = Humidity correction factor.

N = Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

NOx_{conc} = Oxides of nitrogen concentration of the dilute exhaust sample corrected for background, in ppm.

NOx_d = Oxides of nitrogen concentration of the dilute air as measured, in ppm.

NOx_e = Oxides of nitrogen concentration of the dilute exhaust sample as measured, in ppm.

NOx_{mass} = Oxides of nitrogen emissions, in grams per test phase.

P_B = Barometric pressure, in mm. Hg.

P_d = Saturated vapor pressure, in mm. Hg at ambient dry bulb temp.

P_i = Pressure depression below atmospheric measured at the inlet to the positive displacement pump.

T_p = Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, in degrees Rankine.

R_a = Relative humidity of the ambient air, in percent.

V_{mix} = Total dilute exhaust volume in cubic feet per test phase corrected to standard conditions (528°R and 760 mm. Hg).

Vo = Volume of gas pumped by the positive displacement pump, in cubic feet per revolution. This volume is dependent on the pressure differential across the positive displacement pump.

Y_{ct} = Mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

Y_{ht} = Mass emissions as calculated from the "transient" phase of the hot start test, in grams per test phase.

Y_s = Mass emissions as calculated from the "stabilized" phase of the cold start test, in grams per test phase.

Y_{wm} = Weighted mass emissions of each pollutant, i.e., HC, CO, or NOx, in grams per vehicle mile.

For passenger cars, light duty trucks, and medium duty vehicles:

(a) The mass emissions of each pollutant in grams per mile is

$$Y_{wm} = (0.43Y_{ct} + 0.57\ Y_{ht} + Y_s)/7.5$$

(b) The mass of each pollutant for each phase of both the cold start test and the hot start test is determined from the following:

(1) Hydrocarbon mass:

$$HC_{mass} = V_{mix} \times Density_{HC} \times (HC_{conc}/1{,}000{,}000)$$

(2) Oxides of nitrogen mass:

$$NOx_{mass} = V_{mix} \times Density_{NO_2} \times K_H \times (NOx_{conc}/1{,}000{,}000)$$

K_H = humidity correction factor

(3) Carbon monoxide mass:

$$CO_{mass} = V_{mix} \times Density_{CO} \times (CO_{conc}/1{,}000{,}000)$$

(4) Carbon dioxide mass:

$$CO_{2_{mass}} = V_{mix} \times Density_{CO_2} \times (CO_{2_{conc}}/100)$$

$$V_{mix} = \frac{V_o \times N \times (P_b - P_i) \times 528}{(760)(T_p)}$$

$$HC_{conc} = HC_e - HC_d\ (1-1/DF)$$

$$NOx_{conc} = NOx_e - NOx_d\ (1-1/DF)$$

$$CO_{conc} = CO_e - CO_d\ (1-1/DF)$$

$$CO_e = (1-0.02901\ CO_{2_e} - 0.000323\ R_a)\ CO_{em} \text{ for natural gas}$$

$$CO_e = (1-0.02328\ CO_{2_e} - 0.000323\ R_a)\ CO_{em} \text{ for LPG}$$

$$CO_d = (1-0.000323\ R_a)\ CO_{dm}$$

$$K_H = \frac{1}{1-0.0047(H-75)}$$

$$H = \frac{(43.478R_a)(Pd)}{P_B - P_d \times R_a/100}$$

$$DF = \frac{9.77}{CO_{2_e} + (HC_e + CO_e) \times 10^{-4}} \text{ for natural gas}$$

$$DF = \frac{11.7}{CO_{2_e} + (HC_e + CO_e) \times 10^{-4}} \text{ for LPG}$$

For hydrocarbons the Y_{wm} value must be multiplied by the methane content correction factor (MCCF).

$$HC_{wm} = Y_{wm} \times MCCF$$

HC_{wm} = weighted mean HC mass in gms per vehicle mile after correction for methane content

For 1981 and earlier model vehicles, the MCCF values as determined by the vehicle manufacturer and approved by the ARB during certification shall be used. In the absence of such values, the following shall apply:

Gasoline = PC = 0.89 (catalyst only)
PC = 1.0 (non catalyst cars)
LDT = 1.0
MDV = 1.0
HDV = 1.0
Natural Gas = 0.5 (all vehicle categories)
LPG = 0.75 (all vehicle categories)

In the alternative, the applicant may choose to determine the actual MCCF by using the "California Non-Methane Hydrocarbon Test Procedures" adopted May 24, 1978.

For 1982 and later model vehicles, non-methane hydrocarbons must be determined using non-methane instrumentation. In the alternative, the applicant may measure only total hydrocarbons during all testing. However, in such event, no methane credit will be given either gasoline or gaseous fuels.

Sample Calculation:

(i) For the "transient" phase of the cold-start test assume

V_o = 0.29344 cu ft per revolution; N = 10,485;

R_a = 48.2%; P_B = 762 mm Hg; P_d = 22.225 mm Hg; P_i = 70 mm Hg;

T_p = 570°R; HC_e = 105.8 ppm carbon equivalent; NOx_e = 11.2 ppm;

CO_{em} = 306.6 ppm; CO_{2e} = 1.43%; HC_d = 12.1 ppm;

NOx_d = 0.8 ppm; CO_{dm} = 15.3 ppm.

Then, for an LPG fueled vehicle:

$$V_{mix} = \frac{(0.29344)\ (10,485)\ (762-70)\ (528)}{(760)(570)} = 2595.0 \text{ cu ft per test phase}$$

$$H = \frac{(43.478)\ (48.2)\ (22.225)}{762-(22.225X48.2/100)} = 62 \text{ grains of water/pound dry air}$$

$$K_H = \frac{1}{1-0.0047(62-75)} = 0.9424$$

CO_e = (1-0.02328(1.43)-0.000323(48.2))306.6=291.6 ppm

CO_d = (1-0.000323(48.2))15.3=15.1 ppm

$$DF = \frac{11.7}{1.43+(105.8+291.6)X10^{-4}} = 7.961$$

HC_{conc} = 105.8-12.1(1-1/7.961) = 95.22 ppm

HC_{mass} = (2595)(17.28)(95.22/1,000,000) = 4.270 grams per test phase

NOx_{conc} = 11.2-0.8(1-1/7.961)=10.50 ppm

NOx_{mass} = (2595)(54.16)(10.50/1,000,000)(0.9424) = 1.391 grams per test phase

CO_{conc} = (291.6)-15.1(1-1/7.961) = 278.4 ppm

CO_{mass} = (2595)(32.97)(278.4/1,000,000) = 23.82 grams per test phase

(ii) For the "stabilized" portion of the cold-start test assume that similar calculations resulted in HC_{mass} = 0.62 grams per test phase; NOx_{mass} = 1.27 grams per test phase; and CO_{mass} = 5.98 grams per test phase.

(iii) For the "transient" portion of the hot-start test assume that similar calculations resulted in HC_{mass} = 0.51 grams per test phase; NOx_{mass} = 1.38 grams per test phase; and CO_{mass} = 5.01 grams per test phase.

(iv) For an LPG fueled vehicle:

$$HC_{wm} = \frac{(0.43)(4.27)+(0.57)(0.51)+0.62}{7.50} \times 0.75 = 0.275$$

grams per vehicle mile

$$CO_{wm} = \frac{(0.43)(23.82)+(0.57)(5.01)+5.98}{7.50} = 2.54$$

grams per vehicle mile

$$NOx_{wm} = \frac{(0.43)(1.391)+(0.57)(1.38)+1.27}{7.50} = 0.354$$

grams per vehicle mile

10. ~~11.~~ Approval

(a) If, after a review of the data and other information submitted by the manufacturer, the Executive Officer determines that a modification to use LPG or NG conforms to these procedures, he or she will issue an Executive Order of approval for such modifications.

(b) Such Executive Order may be issued upon such terms as the Executive Officer deems necessary to ensure that any modifications to use LPG or NG will meet the requirements of these procedures.

(c) Approval for a conversion system for a given model year is deemed as approval for all previous model years unless specifically limited in the Executive Order. Approval for subsequent model years (i.e., carryover) may be given, after request by the applicant, if further engineering evaluation and/or testing demonstrates that the system will meet the standards for the applicable model year and engine displacements ~~size class~~.

(d) Approval for installation on vehicles with similar emission control systems (i.e., carry-across) may be given, if requested by the applicant, if further engineering evaluation and/or testing demonstrates that the system will meet the standards for the applicable model-year(s) and engine displacement(s).

11. ~~12.~~ Changes to Conversion System After Approval

All changes made to the conversion system, including installation changes, must be submitted to the Executive Officer. The Executive Officer may require additional testing prior to approval.

12. ~~13.~~ Non-conventional Systems

The Executive Officer may deviate from these procedures for non-conventional systems, such as diesel fuel used in conjunction with LPG, in the event that such systems cannot be tested using these procedures. Such deviations shall be limited to those necessary for the proper testing and evaluation of such systems.

State of California
AIR RESOURCES BOARD

Response to Significant Environmental Issues

Item: Public Hearing to Consider Proposed Amendments to Title 13, California Administrative Code, Section 2030, Regarding the Standards and Test Procedures for Approval of Systems Designed to Convert Motor Vehicles to Use Liquefied Petroleum Gas or Natural Gas Fuels

Agenda Item No.: 83-18-2

Public Hearing Date: December 15, 1983

Response Date: August 15, 1984

Issuing Authority: Executive Officer

Comment: No comments were received identifying any significant environmental issues pertaining to this item. The staff report identified no adverse environmental effects.

Response: N/A

CERTIFIED: _____
Executive Officer

Date: 9/14/84

State of California
AIR RESOURCES BOARD

Resolution 83-45

December 15, 1983

Agenda Item No.: 83-18-1

WHEREAS, Health and Safety Code Section 39600 requires the Air Resources Board (the "Board") to do such acts as may be necessary for the proper execution of the powers and duties granted to, and imposed upon, the Board;

WHEREAS, Health and Safety Code Section 43654 requires, with limited exceptions, that every 1966 through 1970 light-duty vehicle subject to registration in this state be equipped with a certified device to control its exhaust emission of oxides of nitrogen ("NOx") upon initial registration and upon transfer of ownership and registration;

WHEREAS, Health and Safety Code Section 43660 provides that the Board shall review the NOx retrofit device requirement of Section 43654 and report to the Legislature not later than January 1, 1984, the Board's findings and recommendations, including a determination of the contribution of the requirement to the maintenance of ambient air quality standards and the cost effectiveness of the requirement;

WHEREAS, the review has been completed and Board staff have prepared a draft report entitled "Report to the Legislature on the Benefits and Cost Effectiveness of the 1966-1970 Model-Year Motor Vehicle Oxides of Nitrogen Retrofit Emission Control Requirements;"

WHEREAS, the Board has held a duly noticed public meeting at which it considered public comments and the draft report prepared and presented to it by staff; and

WHEREAS, the Board finds that the report, after inclusion of the recommended changes and additions, thoroughly and accurately addresses the air quality benefits and the cost effectiveness of the 1966-1970 model-year NOx retrofit requirements.

NOW, THEREFORE, BE IT RESOLVED that the Board approves the "Report to the Legislature on the Benefits and Cost Effectiveness of the 1966-1970 Model-Year Motor Vehicle Oxides of Nitrogen Retrofit Emission Control Requirements" and the findings and recommendations contained therein.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to forward the report to the Legislature in accordance with Health and Safety Code Section 43660.

I certify that the above is a true and correct copy of Resolution 83-45, as adopted by the Air Resources Board.

Harold Holmes

Harold Holmes, Board Secretary

State of California
AIR RESOURCES BOARD

Resolution 83-46

December 15, 1983

WHEREAS, John Doyle has served with distinction as a member of the Air Resources Board (the "Board") from March to December, 1983;

WHEREAS, as mayor and councilman of the City of Palm Springs and as a member of the Board of Directors of the South Coast Air Quality Management District, he has for many years recognized the importance of state and local efforts to control air pollution and has developed extensive knowledge of technical and policy issues relating to air pollution control;

WHEREAS, his calm and considered judgment, knowledge of the issues, willingness to listen to all sides of a question, and familiarity with the technical aspects of the issues have enabled him to make consistent and valuable contributions to the activities of the Board;

WHEREAS, his membership on both the Air Resources Board and the board of the South Coast Air Quality Management District has enabled him to facilitate and encourage an increased degree of cooperation and coordination between the two agencies;

WHEREAS, in addition to his contributions at regular Board meetings, he has dedicated his time and energy as a member of Board committees dealing with regulatory reform and the role of the Board's toxics scientific advisory panel, and as a member of the Architectural Coatings Task Force;

WHEREAS, his personal warmth, intelligence, consideration for others, and dedication to serving the public have won for him the respect and affection of his fellow Board members, the Air Resources Board staff, and members of the public; and

WHEREAS, he will in the future further the interest of his fellow Southern Californians in attaining clean air by continuing as a member of the board of the South Coast Air Quality Management District.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board extends its deepest appreciation and expresses its thanks to John Doyle for his most valuable contribution to achieving California's clean air goals.