

## 27.0 SAMPLING AND TESTING METHODS

### 27.1 General

It is explicitly implied that in addition to and consistent with specific methods of sampling and analysis described herein, that samples shall be taken in such number, duration, and location as to be statistically significant and representative of the condition which the sample(s) purport to evaluate.

Where specific materials, equipment, or procedures are specified, it may be permissible to use other materials, equipment, or procedures where it has been reliably demonstrated that their use produces results comparable to that which would have been obtained by use of the specified materials, equipment, or procedures. All sampling and testing shall be conducted or approved by a professional engineer registered in the State of Tennessee.

### 27.2 Source and Sampling Analysis

The methods set forth in this section shall be applicable for determining compliance with emissions standards. The Director may specify or approve, in specific cases, the use of a referenced method with minor changes in methodology, or may approve the use of an equivalent method or may approve the use of an alternative method, the results of which he has determined to be adequate for indicating whether a specific source is in compliance, or may approve shorter sampling times and smaller sample volumes when necessitated by process variables or other factors. Any equivalent or alternative methods must first be approved by the EPA Administrator.

- A. The following reference methods as specified (and as amended) in 40 CFR 60, Appendix A:

Method 1 - Sample and velocity traverses for stationary sources

Method 1A - Sample and velocity traverses for stationary sources with small stacks or ducts

Method 2 - Determination of stack gas velocity and volumetric flow rate (type S pitot tube)

Method 2A - Direct measurement of gas volume through pipes and small ducts

Method 2B - Determination of exhaust gas volume flow rate from gasoline vapor incinerators

Method 2C - Determination of stack gas velocity and volumetric flow rate in small stacks or ducts (standard pitot tube)

Method 2D - Measurement of gas volumetric flow rates in small pipes and ducts

Method 3 - Gas analysis for carbon dioxide, oxygen, excess air, and dry molecular weight

Method 3A - Determination of oxygen and carbon dioxide concentrations in emissions from stationary sources (instrumental analyzer procedure)

Method 4 - Determination of moisture content in stack gases

Method 5 - Determination of particulate emissions from stationary sources

Method 5A - Determination of particulate emissions from the asphalt processing and asphalt roofing industry

Method 5B - Determination of nonsulfuric acid particulate matter from stationary sources

Method 5C - Reserved

Method 5D - Determination of particulate emissions from positive pressure fabric filters

Method 5E - Determination of particulate emissions from the wool fiberglass insulation manufacturing industry

Method 5F - Determination of nonsulfate particulate matter from stationary sources

Method 5G - Determination of particulate emissions from wood heaters from a dilution tunnel sampling location

Method 5H - Determination of particulate emissions from wood heaters from a stack location

Method 6 - Determination of sulfur dioxide emissions from stationary sources

Method 6A - Determination of sulfur dioxide, moisture, and carbon dioxide emissions from fossil fuel combustion sources

Method 6B - Determination of sulfur dioxide and carbon dioxide daily average emissions from fossil fuel combustion sources

Method 6C - Determination of sulfur dioxide emissions from stationary sources (instrumental analyzer procedure)

Method 7 - Determination of nitrogen oxide emissions from stationary sources

Method 7A - Determination of nitrogen oxide emissions from stationary sources - ion chromatographic method

Method 7B - Determination of nitrogen oxide emissions from stationary sources (ultraviolet spectrophotometry)

Method 7C - Determination of nitrogen oxide emissions from stationary sources--alkaline-permanganate/colorimetric method

Method 7D - Determination of nitrogen oxide emissions from stationary sources--alkaline-permanganate/ion chromatographic method

Method 7E - Determination of nitrogen oxides emissions from stationary sources

(instrumental analyzer procedure)

Method 8 - Determination of sulfuric acid mist and sulfur dioxide emissions from stationary sources

Method 9 - Visual determination of the opacity of emissions from stationary sources

Alternate Method 1 - Determination of the opacity of emissions from stationary sources remotely by lidar

Method 10 - Determination of carbon monoxide emissions from stationary sources

Method 10A - Determination of carbon monoxide emissions in certifying continuous emission monitoring systems at petroleum refineries

Method 10B - Determination of carbon monoxide emissions from stationary sources

Method 11 - Determination of hydrogen sulfide content of fuel gas streams in petroleum refineries

Method 12 - Determination of inorganic lead emissions from stationary sources

Method 13A - Determination of total fluoride emissions from stationary sources--SPADNS zirconium lake method

Method 13B - Determination of total fluoride emissions from stationary sources--specific ion electrode method

Method 14 - Determination of fluoride emissions from potroom roof monitors for primary aluminum plants

Method 15 - Determination of hydrogen sulfide, carbonyl sulfide, and carbon disulfide emissions from stationary sources

Method 15A - Determination of total reduced sulfur emissions from sulfur recovery plants in petroleum refineries

Method 16 - Semicontinuous determination of sulfur emissions from stationary sources

Method 16A - Determination of total reduced sulfur emissions from stationary sources (impinger technique)

Method 16B - Determination of total reduced sulfur emissions from stationary sources

Method 17 - Determination of particulate emissions from stationary sources (in-stack filtration method)

Method 18 - Measurement of gaseous organic compound emissions by gas chromatography

Method 19 - Determination of sulfur dioxide removal efficiency and particulate, sulfur dioxide and nitrogen oxides emission rates

Method 20 - Determination of nitrogen oxides, sulfur dioxide, and diluent emissions from stationary gas turbines

Method 21 - Determination of volatile organic compound leaks

Method 22 - Visual determination of fugitive emissions from material sources and smoke emissions from flares

Method 23 - Determination of Polychlorinated Dibenzo-pDioxins and Polychlorinated Dibenzofurans from Stationary Sources

Method 24 - Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings

Method 24A - Determination of volatile matter content and density of printing inks and related coatings

Method 25 - Determination of total gaseous nonmethane organic emissions as carbon

Method 25A - Determination of total gaseous organic concentration using a flame ionization analyzer

Method 25B - Determination of total gaseous organic concentration using a non-dispersive infrared analyzer

Method 26 - Determination of Hydrogen Chloride Emissions from Stationary Sources

Method 27 - Determination of vapor tightness of gasoline delivery tank using pressure-vacuum test

Method 28 - Certification and auditing of wood heaters

Method 28A - Measurement of air to fuel ratio and minimum achievable burn rates for wood-fired appliances

- B. Stack Gas Velocity Determination: Determination of stack gas velocity (Type S Pitot Tube) shall be determined by the method outlined in the Federal Register, Volume 36, No. 247, December 23, 1971, except in such instances where Type S Pitot Tube is not applicable.
- C. Gas Analysis: Gas analysis for carbon dioxide, excess air, and dry molecular weight shall be accomplished by the method outlined in the Federal Register, Volume 36, No 247, December 23, 1971, or another type of test procedure that is direct indicating and/or recording approved by the Director.
- D. Determination of Moisture in Stack Gases: Moisture shall be determined by the condenser method as specified in the Federal Register, Volume 36, No. 247, December

23, 1971, or other technique approved by the Director.

E. Determination of Particulate Emissions: The basic design of the sampling train is left to the person if certain criteria are observed to assure high collection efficiency and standard analysis of the collected particulates.

1. Description of Sampling Apparatus:

- a. This apparatus shall include interchangeable sampling nozzles or probes of various diameters, a filter effective for the removal of particles exceeding 0.3 micron diameter of solid or liquid, a suitable number of impingers to reduce condensable vapors to liquid or solid particulate matter, and appropriate connecting tubing at temperatures above the aqueous dew point of the gases. All material of construction shall be resistant to corrosive elements in the flue gases, e.g., SO<sub>2</sub>, NO<sub>x</sub>, and elevated temperatures.
- b. This filter assembly shall be maintained above the aqueous dewpoint of the flue gases throughout the sampling operation. To accomplish this the filter assembly may be disposed inside the gas flue to be completely bathed by the hot gas stream; or it may be disposed outside the gas stream provided the following precautions are taken:
  1. If the filter is disposed outside the hot gas flue, a temperature indicator, e.g., thermocouple shall be provided at the sample filter gas exit to monitor the flue gases at all times. Auxiliary heating elements for tubing and filter holder shall be provided to maintain specified temperatures when required.
  2. Deposits in the tube connecting the probe to the exterior filter shall be quantitatively removed by washing with a suitable liquid and by brushing, the weight of solids recovered there from being added to the weight found in the filter.
- c. Provisions shall be included for cooling the gas stream to standard conditions (70°F) to reduce condensable vapors to liquid or solid particulate matter, and for cooling the condensed particles including water that may be formed by condensation of water vapor in the sample. This shall be accomplished by passage through bubblers provided with with an orifice submerged in water through which the gas stream passes at a velocity of approximately 100 meters per second. The bubblers should be immersed in an ice bath to minimize evaporation. A trap of suitable shape and dimensions for the collection of overflow or overspray shall be provided downstream from the bubblers.
- d. An indicating flowmeter shall be provided and preferably located in the train at a point preceding the source of suction, preceded by a trap to prevent condensed water from entering the flowmeter; and a vacuum gauge adjacent to the flowmeter to indicate the absolute pressure of the gas passing through the orifice meter.

- e. Operation charts comprising either graphs or tables shall be prepared and be available as part of the apparatus, to indicate proper sampling rates as a function of gas density in the stack and at the flowmeter.

2. Analytical Results

Analytical results shall be accomplished as outlined in the appendix of the Federal Register, Volume 36, No. 247, December 23, 1971, for the filter catch and washings up to the filter. Inclusion or exclusion of material collected in the impinger train as "particulate matter" and method of analysis will be determined on an individual air contaminant source basis.

3. Equivalent Methods

These procedures demonstrated to yield equivalent results and approved by the Director may be used for sampling and analysis of particulate matter. Stack sampling methods promulgated by the Environmental Protection Agency for specified air contaminant sources are considered to be equivalent methods and therefore acceptable.

- F. Measurement of Sulfur Dioxide in Stack Gases:

1. The approved procedures for measuring Sulfur Dioxide in stack gases are the Shell Development Company method and the Monsanto Company method.

REFERENCE: (1) Shell Development Company Method

Atmospheric Emission from Sulfuric Acid Manufacturing Processes, Public Health Service Publication 999-AP-13 (1965), Appendix B, pages 85-87.

REFERENCE: (2) Monsanto Company Method

Atmospheric Emission from Sulfuric Acid Manufacturing Processes, Public Health Service Publication 999-AP-13(1965), Appendix B, pages 63-84.

2. Equivalent Methods: Many new and improved methods of continuous gaseous monitoring in stacks are now in use. Any method of stack sampling approved by the Director may be used in accordance with good professional practice. Stack sampling methods promulgated by the Environmental Protection Agency for specified air contaminant sources are considered to be equivalent methods and therefore acceptable.

- G. Measurement of Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>) in Stack Gases:

1. The approved procedures for measuring sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) in stack gases are the Shell Development Company Method and the Monsanto Company Method.

REFERENCE: (1) Shell Development Company Method

Atmospheric Emission from Sulfuric Acid Manufacturing Processes, Public

Health Service Publication 999-AP-13 (1965), Appendix B, pages 63-84.

2. Any method of stack sampling approved by the Director may be used in accordance with good professional practice. The stack sampling method promulgated by the Environmental Protection Agency in the Federal Register, Volume 36, No 247, December 23, 1971, is considered to be an equivalent method.

H. Volatile organic compound emission compliance testing shall conform to EPA approved methods. Tests to determine the VOC content of coatings conform to EPA Method 24. Additionally, EPA or the Department may verify test data submitted by companies with independent tests and EPA or the Department conducted test will take precedence.

THIS IS THE FEDERALLY APPROVED REGULATION AS OF APRIL 28, 1993

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Original Reg	AUG 17, 1972	OCT 28, 1972	37FR23085
1st Revision	JUL 07, 1986	AUG 03, 1989	54FR31953
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