§ 50.18 National primary ambient air quality standards for PM$_{2.5}$

(a) The national primary ambient air quality standards for PM$_{2.5}$ are 12.0 micrograms per cubic meter ($\mu$g/m$^3$) annual arithmetic mean concentration and 35 $\mu$g/m$^3$ 24-hour average concentration measured in the ambient air as PM$_{2.5}$ (particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers) by either:

(1) A reference method based on appendix L to this part and designated in accordance with part 53 of this chapter; or

(2) An equivalent method designated in accordance with part 53 of this chapter.

(b) The primary annual PM$_{2.5}$ standard is met when the annual arithmetic mean concentration, as determined in accordance with appendix N of this part, is less than or equal to 12.0 $\mu$g/m$^3$.

(c) The primary 24-hour PM$_{2.5}$ standard is met when the 98th percentile 24-hour concentration, as determined in accordance with appendix N of this part, is less than or equal to 35 $\mu$g/m$^3$.

(75 FR 35592, June 22, 2010)

APPENDIX A–1 TO PART 50—REFERENCE MEASUREMENT PRINCIPLE AND CALIBRATION PROCEDURE FOR THE MEASUREMENT OF SULFUR DIOXIDE IN THE ATMOSPHERE (ULTRAVIOLET FLUORESCENCE METHOD)

1.0 APPLICABILITY

1.1 This ultraviolet fluorescence (UVF) method provides a measurement of the concentration of sulfur dioxide (SO$_2$) in ambient air for determining compliance with the national primary and secondary ambient air quality standards for sulfur oxides (sulfur dioxide) as specified in §50.4, §50.5, and §50.17 of this chapter. The method is applicable to the measurement of ambient SO$_2$ concentrations using continuous (real-time) sampling.
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4.1 Apparatus: Figure 2 shows a typical generic system suitable for diluting a SO\(_2\) gas cylinder concentration standard with clean air through a mixing chamber to produce the desired calibration concentration standards. A valve may be used to conveniently divert the SO\(_2\) from the sampling manifold to provide clean zero air at the output manifold for zero adjustment. The system may be made up using common laboratory components, or it may be a commercially manufactured system. In either case, the principle components are as follows:

4.1.1 SO\(_2\) standard gas flow control and measurement devices (or a combined device) capable of regulating and maintaining the standard gas flow rate constant to within ±2 percent and measuring the gas flow rate accurate to within ±2, properly calibrated to a NIST-traceable standard.

4.1.2 Dilution air flow control and measurement devices (or a combined device) capable of regulating and maintaining the air flow rate constant to within ±2 percent and measuring the air flow rate accurate to within ±2, properly calibrated to a NIST-traceable standard.

4.1.3 Mixing chamber, of an inert material such as glass and of proper design to provide thorough mixing of pollutant gas and diluent air streams.

4.1.4 Sampling manifold, constructed of glass, polytetrafluoroethylene (PTFE Teflon\(^{TM}\)), or other suitably inert material and of sufficient diameter to insure a minimum over-pressure (relative to ambient air pressure) at the analyzer connection and to prevent ambient air from entering the manifold.

4.1.5 Standard gas pressure regulator, of clean stainless steel with a stainless steel diaphragm, suitable for use with a high pressure SO\(_2\) gas cylinder.

4.1.6 Reagents

4.1.6.1 SO\(_2\) gas concentration transfer standard having a certified SO\(_2\) concentration of not less than 10 ppm, in N\(_2\) traceable to a NIST Standard Reference Material (SRM).

4.1.6.2 Clean zero air, free of contaminants that could cause a detectable response or a change in sensitivity of the analyzer. Since ultraviolet fluorescence analyzers may be sensitive to aromatic hydrocarbons and O\(_3\)-to-N\(_2\) ratios, it is important that the clean zero air contains less than 0.1 ppm aromatic hydrocarbons and O\(_3\) and N\(_2\) percentages approximately the same as in ambient air. A procedure for generating zero air is given in reference 1.

4.2 Procedure

4.2.1 Obtain a suitable calibration apparatus, such as the one shown schematically in Figure 1, and verify that all materials in contact with the pollutant are of glass, Teflon\(^{TM}\), or other suitably inert material and completely clean.

4.2.2 Purge the SO\(_2\) standard gas lines and pressure regulator to remove any residual air.

4.2.3 Ensure that there are no leaks in the system and that the flow measuring devices are properly and accurately calibrated under the conditions of use against a reliable volume or flow rate standard such as a soap-bubble meter or a wet-test meter traceable to a NIST standard. All volumetric flow rates should be corrected to the same reference temperature and pressure by using the formula below:

\[
F_c = F_m \frac{298.15P_m}{760(T_m + 273.15)}
\]

Where:

\(F_c\) = corrected flow rate (L/min at 25 °C and 760 mm Hg),
4.2.4 Allow the SO\(_2\) analyzer under calibration to sample zero air until a stable response is obtained, then make the proper zero adjustment.

4.2.5 Adjust the airflow to provide an SO\(_2\) concentration of approximately 80 percent of the upper measurement range limit of the SO\(_2\) instrument and verify that the total air flow of the calibration system exceeds the demand of all analyzers sampling from the output manifold (with the excess vented).

4.2.6 Calculate the actual SO\(_2\) calibration concentration standard as:

\[
[SO_2] = \frac{F_p}{F_t} C
\]

Where:
- \(C\) = the concentration of the SO\(_2\) gas standard
- \(F_p\) = the flow rate of SO\(_2\) gas standard
- \(F_t\) = the total air flow rate of pollutant and diluent gases

4.2.7 When the analyzer response has stabilized, adjust the SO\(_2\) span control to obtain the desired response equivalent to the calculated standard concentration. If substantial adjustment of the span control is needed, it may be necessary to re-check the zero and span adjustments by repeating steps 4.2.4 through 4.2.7 until no further adjustments are needed.

4.2.8 Adjust the flow rate(s) to provide several other SO\(_2\) calibration concentrations over the analyzer’s measurement range. At least five different concentrations evenly spaced throughout the analyzer’s range are suggested.

4.2.9 Plot the analyzer response (vertical or Y-axis) versus SO\(_2\) concentration (horizontal or X-axis). Compute the linear regression slope and intercept and plot the regression line to verify that no point deviates from this line by more than 2 percent of the maximum concentration tested.

NOTE: Additional information on calibration and pollutant standards is provided in Section 12 of Reference 3.

5.0 FREQUENCY OF CALIBRATION

The frequency of calibration, as well as the number of points necessary to establish the calibration curve and the frequency of other performance checking will vary by analyzer; however, the minimum frequency, acceptance criteria, and subsequent actions are specified in Reference 3, Appendix D: Measurement Quality Objectives and Validation Template for SO\(_2\) (page 9 of 30). The user’s quality control program should provide guidelines for initial establishment of these variables and for subsequent alteration as operational experience is accumulated. Manufacturers of analyzers should include in their instruction/operation manuals information and guidance as to these variables and on other matters of operation, calibration, routine maintenance, and quality control.

6.0 REFERENCES FOR SO\(_2\) METHOD


Figure 1. UVF SO₂ analyzer schematic diagram.
APPENDIX A–2 TO PART 50—REFERENCE METHOD FOR THE DETERMINATION OF SULFUR DIOXIDE IN THE ATMOSPHERE (PARAROSANILINE METHOD)

1.0 Applicability.
1.1 This method provides a measurement of the concentration of sulfur dioxide (SO₂) in ambient air for determining compliance with the primary and secondary national ambient air quality standards for sulfur oxides (sulfur dioxide) as specified in §50.4 and §50.5 of this chapter. The method is applicable to the measurement of ambient SO₂ concentrations using sampling periods ranging from 30 minutes to 24 hours. Additional quality assurance procedures and guidance are provided in part 58, appendices A and B, of this chapter and in references 1 and 2.

2.0 Principle.
2.1 A measured volume of air is bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM). The SO₂ present in the air stream reacts with the TCM solution to form a stable monochlorosulfonatomercurate(3) complex. Once formed, this complex resists air oxidation(4, 5) and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid-bleached pararosaniline dye and formaldehyde to form an intensely colored pararosaniline methyl sulfonic acid.

3.0 Range.
3.1 The lower limit of detection of SO₂ in 10 mL of TCM is 0.75 μg (based on collaborative