6560-50-P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 50

[EPA-HQ-OAR-2022-0007; FRL-9344-02-OAR]

RIN 2060-AV63

Reference Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere (Chemiluminescence Method)

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: The Environmental Protection Agency (EPA) is finalizing an update to the current ozone absorption cross-section to the recommended consensus-based cross-section value of 1.1329×10^{-17} cm^2 $molecule^{-1}$ or 304.39 atm^{-1} cm^{-1}, with an uncertainty of 0.94 atm^{-1} cm^{-1}. The new value is 1.2% lower than the current value of 308 atm^{-1} cm^{-1} and reduces the uncertainty in the value to 0.31%. The adoption of this updated ozone absorption cross-section could result in increases in measured ozone concentrations but given the existing sources of potential variability in monitoring data, it is unlikely that there will be any consistent measurable and predictable effect on reported data. The EPA is also updating the dates of publication for two references associated with the updated cross-section value, adding a new reference, and making a technical correction to move three figures inadvertently placed in section 6.0 *References* to a new section 7.0 *Figures*.

DATES: This final rule is effective on **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

ADDRESSES: The EPA has established a docket for this action under Docket ID No. EPA-HQ-OAR-2022-0007. All documents in the docket are listed on the *https://www.regulations.gov* web site. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form.

Publicly available docket materials are available electronically through *https://www.regulations.gov*.

FOR FURTHER INFORMATION CONTACT: Ms. Joann Rice, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Ambient Air Monitoring Group (C304-06), Environmental Protection Agency, Research Triangle Park, North Carolina 27711; telephone number: (919) 541-3372; email address: *rice.joann@epa.gov*.

SUPPLEMENTARY INFORMATION:

Organization of this document. The information in this preamble is organized as follows:

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I. Background

In 1961, the ozone absorption cross-section was measured to be 1.1476 x10^{-17} cm^2 $molecule^{-1}$ or 308.3 atmosphere $(atm)^{-1}$ centimeter $(cm)^{-1}$ with a reported relative standard uncertainty of 1.4% (Hearn, 1961).[1] In the 1980s, the National Institute of Standards and Technology (NIST), in collaboration with the EPA, developed the Standard Reference

[1] Hearn A. G. (1961). Absorption of ozone in ultra-violet and visible regions of spectrum, *Proc. Phys. Soc. 78 932,* DOI: 10.1088/0370-1328/78/5/340.

Photometer (SRP), which is the international standard for the measurement of ozone. The SRP is based on ultraviolet (UV) photometry and uses this cross-section value as the reference value for UV ozone measurements. To establish and maintain traceability, the readings of an ozone analyzer are compared to a NIST-made ozone SRP through a hierarchy of standards. Efforts to improve the accuracy of the ozone absorption cross-section have continued over several years during which rigorous assessment of the bias and uncertainty in the value became a high priority.

The Gas Analysis Working Group of the Consultive Committee for Metrology in Chemistry and Biology (CCQM-GAWG) of the Bureau of Weights and Measures in France (BIPM) convened a task group in 2016 to review all published measurements of the ozone cross-section since 1950. This task group was also charged with recommending a consensus-based cross-section value and associated uncertainty for adoption in measurements of ozone concentrations by standard UV photometric instruments, including the SRP. (Hodges et al., 2019)[2].

After publication in Hodges et al., 2019, the CCQM-GAWG[3] convened an international group of stakeholders in October 2020 to discuss adopting and implementing a globally coordinated change in the cross-section value for surface ozone monitoring. This group, representing several international and national metrology institutes, NIST, and environmental agencies including EPA, agreed to adopt and implement the new cross-section value as it represents a more accurate value with less uncertainty and is an advancement and improvement in the UV photometer measurement method.

40 CFR part 50, appendix D, "Reference Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere," currently provides EPA's ozone calibration procedure with a stated value of 308 ± 4 atm^{-1} cm^{-1}. This final action updates the

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[2] Hodges, J.T., Viallon, J., Brewer, P.J., Drouin, B.J., Gorshelev, V., Janssen, C., Lee, S., Possolo, A., Smith, M.A.H., Walden, and Wielgosz, R.I. (2019). Recommendation of a consensus value of the ozone absorption cross-section at 253.65 nm based on a literature review, Metrologia, 56, 034001. *https://doi.org/10.1088/1681-7575/ab0bdd.*

[3] *https://www.bipm.org/en/committees/cc/ccqm/wg/ccqm-gawg-ozone-tg.*

ozone absorption cross-section to align with the BIPM CCQM-GAWG's updated international cross-section value of 304.39 atm^{-1} cm^{-1} with an uncertainty of 0.94 atm^{-1} cm^{-1} at standard temperature and pressure of 0°C and 1 atmosphere. The EPA agrees that the new cross-section value results in an improvement in the accuracy of surface ozone monitoring measurements by reducing uncertainty and is finalizing the change in appendix D of part 50 to this more accurate consensus value.

The updated value reduces the uncertainty to 0.31% from the current 1.4%. The value is also 1.2% lower than the current value of 308 atmosphere atm^{-1} cm^{-1}, a change that could result in increases in measured ozone concentrations. However, there are several factors that EPA believes make it unlikely that this change will have a measurable, predictable influence on any particular set of ozone monitoring data.

Design values, the metric used to compare ambient ozone concentrations measured at a monitor to the National Ambient Air Quality Standard (NAAQS) to determine compliance, are determined using the data reporting, data handling, and computation procedures provided in 40 CFR part 50, appendix U, "Interpretation of the Primary and Secondary National Ambient Air Quality Standards for Ozone."

Multiple factors can contribute to variability in monitoring data and ultimately design values, including, but not limited to, the precision of the monitoring method, the acceptance criteria for Standard Reference Photometer (SRP) calibration and verification, the acceptance criterion for bench and field standards used to calibrate ozone monitors in the field, how agencies perform calibration and adjust analyzer response, the precision and bias acceptance criteria in EPA's Quality Assurance (QA) Handbook,[4] data handling and computation procedures in Appendix U, and meteorology.

The inherent precision (variability) of the measurements from analyzers used to measure

[4] Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, EPA-454/B-17-001, Jan. 2017, available at: *https://www.epa.gov/sites/default/files/2020-10/documents/final_handbook_document_1_17.pdf*.

ozone is about ±1 ppb, or ±0.001 ppm. The variability in the measurement in either the positive or negative direction should be considered relative to the change in monitoring data due to the new cross-section value.

When the new cross-section value is implemented, all SRPs maintained by BIPM, NIST, and the EPA will be updated to incorporate the new value. The update will be achieved through software/firmware modification and will not require any hardware changes. The EPA is planning to update all Agency's SRPs simultaneously, instead of through a phased approach, to minimize disruption of the SRP network. To establish and maintain traceability, the readings of an ozone analyzer are compared through a hierarchy of standards to a NIST ozone SRP. The process of using NIST-traceable standards to verify the ozone concentrations is implemented for all regulatory network ozone analyzers used for comparison to the NAAQS. There are 12 SRPs within the EPA's network: three at EPA's Office of Research and Development (ORD) and nine at various EPA Regional offices and the California Air Resources Board (CARB). One of ORD's SRPs is sent to NIST to be re-verified against the NIST SRP annually. That SRP serves as the reference for the two other ORD SRPs. Each SRP in the U.S. is re-verified against one of ORD's three SRPs annually. Under normal verification operations, implementing the ozone standards traceability process for the entire SRP network could take 2 or more years starting from when the SRP software/firmware is updated. During this time, the implementation progress and monitoring data collected with the new cross-section will need to be tracked.

The acceptance criteria used in comparing the SRPs (Level 1 standards) to each other is a slope of 1.00 ± 0.01 (or 1%) and an intercept 0.00 ± 1 ppb. Field and bench standards (Level 2 standard) used to calibrate ozone analyzers in the field have acceptance criteria for the slope of 1.00 ± 0.03 (or 3%) and an intercept of 0 ± 3 ppb. The 1.2% change in cross-section value is well within the 3% acceptance for Level 2 standards.

The goal for annual measurement uncertainty for ozone in 40 CFR part 58, "Ambient Air Quality Surveillance," is an upper 90 percent confidence limit for the coefficient of variation of

7% for precision and for bias an upper 95 percent confidence limit of 7%. Bias and precision estimates are determined using data obtained from the comparison of the ozone analyzer response to one-point Quality Control (QC) checks using a Level 2 calibration standard. The 1.2% change in cross-section value is well within the bias and precision goal of 7%. Data reported to the EPA's Air Quality System by state, local, and tribal monitoring agencies is used to assess bias and precision. The 2021 national average precision for all ozone analyzers in the U.S. is 2.3% and the national average bias is 1.6%.[5] The 1.2% change is, therefore, within the national precision and less than the national bias.

The QA Handbook, Volume II, Appendix D Validation Template[6] also specifies critical criteria for monitoring organizations to maintain the integrity and evaluate the quality of the data collected by the analyzer. The critical criteria are a one-point QC check (every 14 days at a minimum) < ±7.1% difference or < ±1.5 ppb difference, whichever is greater; zero drift < ± 3.1 ppb (over a 24-hour period) or < ±5.1 ppb (> 24 hours and up to 14 days); and span check drift over a 14-day period of < ±7.1%. Any change to monitoring data due to the new cross-section is also well within the 7.1% acceptance criteria. Monitoring organizations may manually adjust the analyzer response while others may institute automated adjustment through use of a data acquisition or data handling system. Automated adjustments to the ozone analyzer data are not recommended because the monitoring agency may not know if the standard being used for monitor comparison, or the analyzer, has degraded or drifted.

Ozone analyzers are calibrated or verified every 182 days if one-point zero and span checks are performed every 14 days, and every 365 days if one-point zero and span checks are done daily. The acceptance criteria for multi-point calibration are all points < ±2.1% or ≤ ±1.5 ppb difference of the best fit straight line, whichever is greater, and a slope of 1 ± 0.05 or 5%.

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[5] Data obtained on 9/1/2022 from EPA's Ozone Data Quality Dashboard: *https://sti-r-shiny.shinyapps.io/ozone_dashboard/*.

[6] Appendix D, Measurement Quality Objectives and Validation Templates: *https://www.epa.gov/sites/default/files/2020-10/documents/app_d_validation_template_version_03_2017_for_amtic_rev_1.pdf*.

The 1.2% change is also well within this acceptance criteria for ozone monitor calibration.

Ozone design values are computed as the 3-year average of the annual 4th highest daily maximum 8-hour value measured at each monitoring site. Appendix U provides for three levels of truncation for the hourly, daily 8-hour maximum, and design value calculations. Hourly averaged ozone monitoring data are to be reported in ppm to the third decimal place, with additional digits to the right truncated (*e.g.*, 0.070 ppm). In assessing how and if the updated cross-section value may affect ozone design values, it is important to note that other factors, including meteorology, can also influence design values. The effects of meteorology on hourly ozone concentrations can contribute to an increase or decrease in design values for a site because formation of ozone is heavily dependent on meteorological conditions. Interannual meteorological variations are known to affect daily and seasonal average ozone concentrations. Therefore, while we do not have reason to believe this proposal will significantly increase design values, meteorology would be a confounding factor in determining the effect on 3-year design values.

Taking these factors into consideration, the EPA believes it is unlikely that the cross-section change will have a measurable, predictable influence on any given ozone design value or monitoring data set.

Because the EPA believes that adoption of the new cross-section will improve the accuracy of measured ozone values and is unlikely to have a measurable, predictable influence on any given monitor or design value, the EPA is finalizing its proposal to revise the current ozone absorption cross-section to the recommended international consensus-based cross-section value of 304.39 atm^{-1} cm^{-1}, with an uncertainty of 0.94 atm^{-1} cm^{-1}.

Ozone analyzers are traceable to a NIST standard reference UV-based photometer with a specified ozone UV absorption cross-section value. The absorption cross-section value stated this appendix (304.39 atm^{-1} cm^{-1} ± 0.94 atm^{-1} cm^{-1}) will be implemented January 1, 2025, with an additional year for state, local, and tribal monitoring agencies to complete implementation, to

January 1, 2026. Until January 1, 2025, the previous ozone absorption cross-section value (308 ± 4 atm^{-1} cm^{-1}) will be used. After January 1, 2025, both cross-section values, 304.39 ± 0.94 atm^{-1} cm^{-1} and 308 ± 4 atm^{-1} cm^{-1}, may be used. After January 1, 2026, only the cross-section value of 304.39 ± 0.94 atm^{-1} cm^{-1} may be used. EPA recognizes the challenges, complexity, and time it will take to develop guidance and complete implementation of the updated cross-section value and is, therefore, delaying the proposed implementation start date of January 1, 2024, until January 1, 2025, with an additional year (to January 1, 2026) to complete implementation.

The EPA is including an additional published reference for the research done to support the cross-section change in 40 CFR part 50, appendix D, section 6.0 *References*: Hodges, J.T., Viallon, J., Brewer, P.J., Drouin, B.J., Gorshelev, V., Janssen, C., Lee, S., Possolo, A., Smith, M.A.H., Walden, and Wielgosz, R.I., "Recommendation of a consensus value of the ozone absorption cross-section at 253.65 nm based on a literature review," Metrologia, 56 (2019) 034001, *https://doi.org/10.1088/1681-7575/ab0bdd*. The EPA is also changing the publication dates of two existing references associated with the updated cross-section value in 40 CFR part 50, appendix D, section 6.0 *References.*

Comments on the Proposed Rule

On February 24, 2023, the EPA proposed to update the current ozone absorption cross-section (88 FR 11835) and solicited comment on the proposed update. The EPA received two comments by the close of the public comment period on March 27, 2023. One commenter expressed concern that the proposed target date of January 1, 2024, provides insufficient time to implement the new cross-section value and noted that monitoring equipment that is no longer supported by manufacturers would require monitoring agencies to purchase new ozone monitoring equipment.

In further consideration of global implementation of the updated cross-section value, the international task group leading implementation and the EPA recognize the challenges, complexity, and time it will take to implement the updated value and are accordingly delaying the implementation start date from January 2024 until January 2025 with an additional year (to January 2026) to complete implementation. Regarding the assertion that some monitoring agencies will be required to purchase new equipment, existing equipment will be adjusted by firmware updates if available. Where firmware updates are not available for certain monitors, those monitors may instead be calibrated against ozone transfer standards, which are calibrated directly back to a Standard Reference Photometer (SRP) using the updated cross-section value. Therefore, the purchase of new equipment should not be required.

A second comment on the proposed cross-section value assumed that the percentage increase in monitoring data would be 0.00086 ppm at the current level of the standard (0.070 ppm). The commenter noted that, if that increase had been applied to the health studies upon which the current NAAQS is based, "a NAAQS closer to 71 ppb very well could have been chosen based on the monitoring data." The commenter also noted that under the current ozone reconsideration, the Clean Air Science Advisory Committee (CASAC) and EPA "must" consider the ozone cross-section change on monitoring data and health effect studies and, if not considered, the NAAQS may be "artificially lowered" or more stringent.

The EPA disagrees that this change will make the NAAQS ozone standard more stringent. As described in the proposed action, at the current level of the standard (0.070 ppm), 0.00086 ppm is within the current precision of the measurement method which is +/- 0.001 ppm. Moreover, when viewed in conjunction with the current monitor calibration acceptance criteria[7], the use of truncation conventions for the ozone hourly, daily 8-hour maximum, and design value calculations, and other unpredictable factors, EPA disagrees with the commenter's suggestion that the change will result in any consistent measurable and predictable effect on reported data. This inherent measurement variability is already included in the measurements that have been and are being used in health effects research studies related to the ozone NAAQS. The CASAC

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[7] See *QA Handbook, Vol. II, App. D, Measurement Quality Objectives and Validation Templates,* available at *https://www.epa.gov/sites/default/files/2020-10/documents/app_d_validation_template_version_03_2017_for_amtic_rev_1.pdf*.

is aware of this action, which is required to bring the U.S. into alignment with international monitoring standards.

No other comments were received. The EPA is finalizing this action as proposed.

II. Statutory and Executive Orders Reviews

Additional information about these statutes and Executive Orders can be found at *https://www.epa.gov/laws-regulations/laws-and-executive-orders*.

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 14094: Modernizing Regulatory Review

This action is not a significant regulatory action as defined by Executive Order 12866, as amended by Executive Order 14094 and was, therefore, not subject to a requirement for Executive Order 12866 review.

B. Paperwork Reduction Act (PRA)

This action does not impose an information collection burden under the PRA. This action revises the ozone absorption cross-section and revise and amend relevant references. It does not contain any information collection activities.

C. Regulatory Flexibility Act (RFA)

I certify that this action will not have a significant economic impact on a substantial number of small entities under the RFA. In making this determination, the EPA concludes that the impact of concern for this rule is any significant adverse economic impact on small entities and that the agency is certifying that this rule will not have a significant economic impact on a substantial number of small entities if the rule has no net burden on the small entities subject to the rule. This action updates the ozone absorption cross-section value for surface ozone monitoring under 40 CFR part 50, and we anticipate that there will be minimal costs associated with this change. We have, therefore, concluded that this action will have no net regulatory burden for all directly regulated small entities.

D. Unfunded Mandates Reform Act (UMRA)

This action does not contain any unfunded mandate as described in UMRA, 2 U.S.C. 1531–1538 and does not significantly or uniquely affect small governments. This action imposes no enforceable duty on any state, local, or tribal governments, or the private sector.

E. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government.

F. Executive Order 13175: Consultation and Coordination with Indian Tribal Governments

This action does not have tribal implications as specified in Executive Order 13175. This action updates a reference measurement principle and calibration procedure for the measurement of ambient ozone under 40 CFR part 50. Thus, Executive Order 13175 does not apply to this action.

G. Executive Order 13045: Protection of Children from Environmental Health Risks and Safety Risks

The EPA interprets Executive Order 13045 as applying only to those regulatory actions that concern environmental health or safety risks that the EPA has reason to believe may disproportionately affect children, per the definition of “covered regulatory action” in section 2-202 of the Executive Order. This action is not subject to Executive Order 13045 because it does not concern an environmental health risk or safety risk.

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution or Use

This action is not subject to Executive Order 13211, because it is not a significant regulatory action under Executive Order 12866.

I. National Technology Transfer and Advancement Act (NTTAA)

This rulemaking involves technical standards. The EPA used voluntary consensus standards in the preparation of this measurement principle and procedure; it is the benchmark against which all ambient ozone monitoring methods are compared. This action is simply updating the reference measurement principle in light of updated information.

J. Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629, Feb.16, 1994) directs Federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations (people of color) and low-income populations.

The EPA believes that this type of action does not concern human health or environmental conditions and, therefore, cannot be evaluated with respect to potentially disproportionate and adverse effects on people of color, low-income populations and/or indigenous peoples. This regulatory action is an update to a previously promulgated analytical method and does not have any impact on human health or the environment.

K. Congressional Review Act (CRA)

This action is subject to the CRA, and the EPA will submit a rule report to each house of the Congress and to the Comptroller General of the United States. This action is not a "major rule" as defined by 5 U.S.C. 804(2).

List of Subjects in 40 CFR Part 50

Environmental protection, Air pollution control, Ozone.

Michael S. Regan,
Administrator.

For the reasons set forth in the preamble, the EPA amends title 40, chapter I of the Code of Federal Regulations as follows:

PART 50—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

1. The authority citation for part 50 continues to read as follows:

Authority: 42 U.S.C. 7401, *et seq*.

2. Amend appendix D to part 50 by:

a. Revising sections 2.2, 4.1 and 4.5.3.10;

b. Revising references 13. and 14. in section 6.0;

c. Removing figures 1., 2., and 3. in section 6.0;

d. Adding reference 15 in section 6.0; and

e. Adding section "7.0 *Figures*.".

The revisions and addition read as follows:

Appendix D to Part 50-Reference Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere (Chemiluminescence Method)

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2.0 ***Measurement Principle.***

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2.2 The measurement system is calibrated by referencing the instrumental chemiluminescence measurements to certified O_3 standard concentrations generated in a dynamic flow system and assayed by ultraviolet (UV) photometry to be traceable to a National Institute of Standards and Technology (NIST) standard reference photometer for O_3 (see section 4, Calibration Procedure, below) with a specified ozone absorption cross-section value. The absorption cross-section value stated in section 4.1 and section 4.5.3.10 of this appendix (304.39 atm^{-1} cm^{-1} ± 0.94 atm^{-1} cm^{-1}) will be implemented January 1, 2025, with an additional year to complete implementation (January 1, 2026). Until January 1, 2025, the previous ozone absorption cross-section value, 308 ± 4 atm^{-1} cm^{-1}, will be used. After January 1, 2025, both cross-section values, 304.39 ± 0.94 atm^{-1} cm^{-1} and 308 ± 4 atm^{-1} cm^{-1}, may be used. After January 1, 2026, only the cross-section value of 304.39 ± 0.94 atm^{-1} cm^{-1} may be used.

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4.0 ***Calibration Procedure.***

4.1 *Principle*. The calibration procedure is based on the photometric assay of O_3 concentrations in a dynamic flow system. The concentration of O_3 in an absorption cell is determined from a measurement of the amount of 254 nm light absorbed by the sample. This determination requires knowledge of (1) the absorption coefficient (α) of O_3 at 254 nm, (2) the optical path length (l) through the sample, (3) the transmittance of the sample at a nominal wavelength of 254 nm, and (4) the temperature (T) and pressure (P) of the sample. The transmittance is defined as the ratio I/I_0, where I is the intensity of light which passes through the cell and is sensed by the detector when the cell contains an O_3 sample, and I_0 is the intensity of light which passes through the cell and is sensed by the detector when the cell contains zero air. It is assumed that all conditions of the system, except for the contents of the absorption cell, are identical during measurement of I and I_0. The quantities defined above are related by the Beer-Lambert absorption law,

$$\text{Transmitance} = \frac{I}{I_0} = e^{-\alpha cl} \quad (1)$$

Where:

α = absorption coefficient of O_3 at 254 nm = 304.39 atm^{-1} cm^{-1}, with an uncertainty of 0.94 atm^{-1} cm^{-1} at 0 °C and 1 atm. [1, 2, 3, 4, 5, 6, 7, 15]

c = O_3 concentration in atmospheres, and

l = optical path length in cm.

A stable O_3 generator is used to produce O_3 concentrations over the required calibration concentration range. Each O_3 concentration is determined from the measurement of the transmittance (I/I_0) of the sample at 254 nm with a photometer of path length l and calculated from the equation,

$$c(\text{atm}) = -\frac{1}{\alpha l}\left(\ln\frac{I}{I_0}\right) \quad (2a)$$

or

$$c(\text{ppm}) = -\frac{10^6}{\alpha l}\left(\ln\frac{I}{I_0}\right). \quad (2b)$$

The calculated O_3 concentrations must be corrected for O_3 losses, which may occur in the photometer, and for the temperature and pressure of the sample.

* * * * *

4.5 ***Procedure.***

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4.5.3.10. Calculate the O_3 concentration from equation 4. An average of several determinations will provide better precision.

$$[O_3]_{OUT} = \left(\frac{-1}{\alpha l}\ln\frac{I}{I_0}\right)\left(\frac{T}{273}\right)\left(\frac{760}{P}\right) \times \frac{10^6}{L} \quad (4)$$

Where:

$[O_3]_{OUT}$ = O_3 concentration, ppm

α = absorption coefficient of O_3 at 254 nm = 304.39 atm^{-1} cm^{-1} at 0 °C and 1 atm

l = optical path length, cm

T = sample temperature, K

P = sample pressure, torr

L = correction factor for O_3 losses from 4.5.2.5 = (1−fraction of O_3 lost).

Note: Some commercial photometers may automatically evaluate all or part of equation 4. It is the operator's responsibility to verify that all of the information required for equation 4 is obtained, either automatically by the photometer or manually. For "automatic" photometers which evaluate the first term of equation 4 based on a linear approximation, a manual correction may be required, particularly at higher O3 levels. See the photometer instruction manual and Reference 13 for guidance.

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6.0 ***References.***

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13. Technical Assistance Document for the Calibration of Ambient Ozone Monitors, EPA publication number EPA-454/B-22-003, January 2023.

14. QA Handbook for Air Pollution Measurement Systems - Volume II. Ambient Air Quality Monitoring Program. EPA-454/B-17-001, January 2017.

15. Hodges, J.T., Viallon, J., Brewer, P.J., Drouin, B.J., Gorshelev, V., Janssen, C., Lee, S., Possolo, A., Smith, M.A.H., Walden, and Wielgosz, R.I., Recommendation of a consensus value of the ozone absorption cross-section at 253.65 nm based on a literature review, *Metrologia,* 56 (2019) 034001. [Available at *https://doi.org/10.1088/1681-7575/ab0bdd.*]

7.0 ***Figures.***

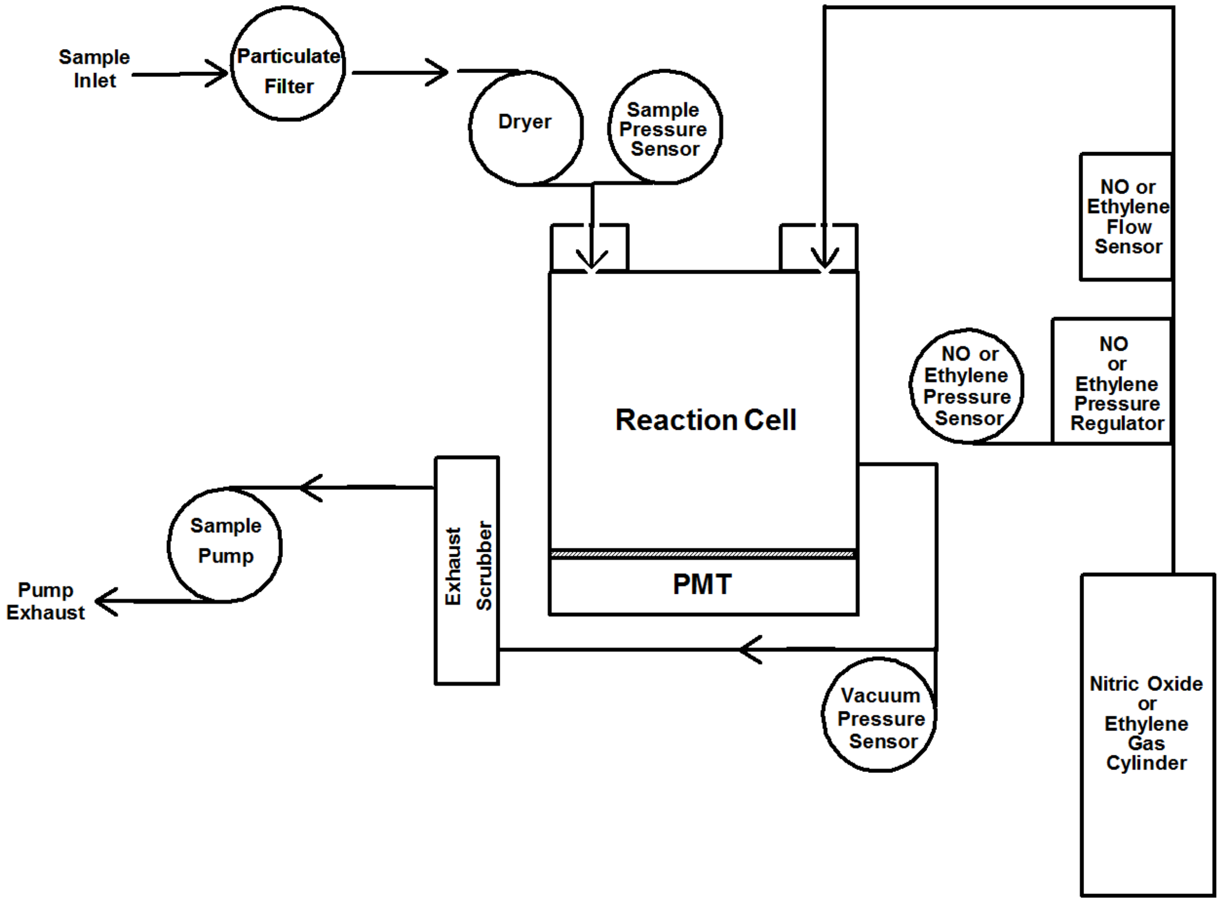

Figure 1. Gas-phase chemiluminescence analyzer schematic diagram, where PMT means photomultiplier tube.

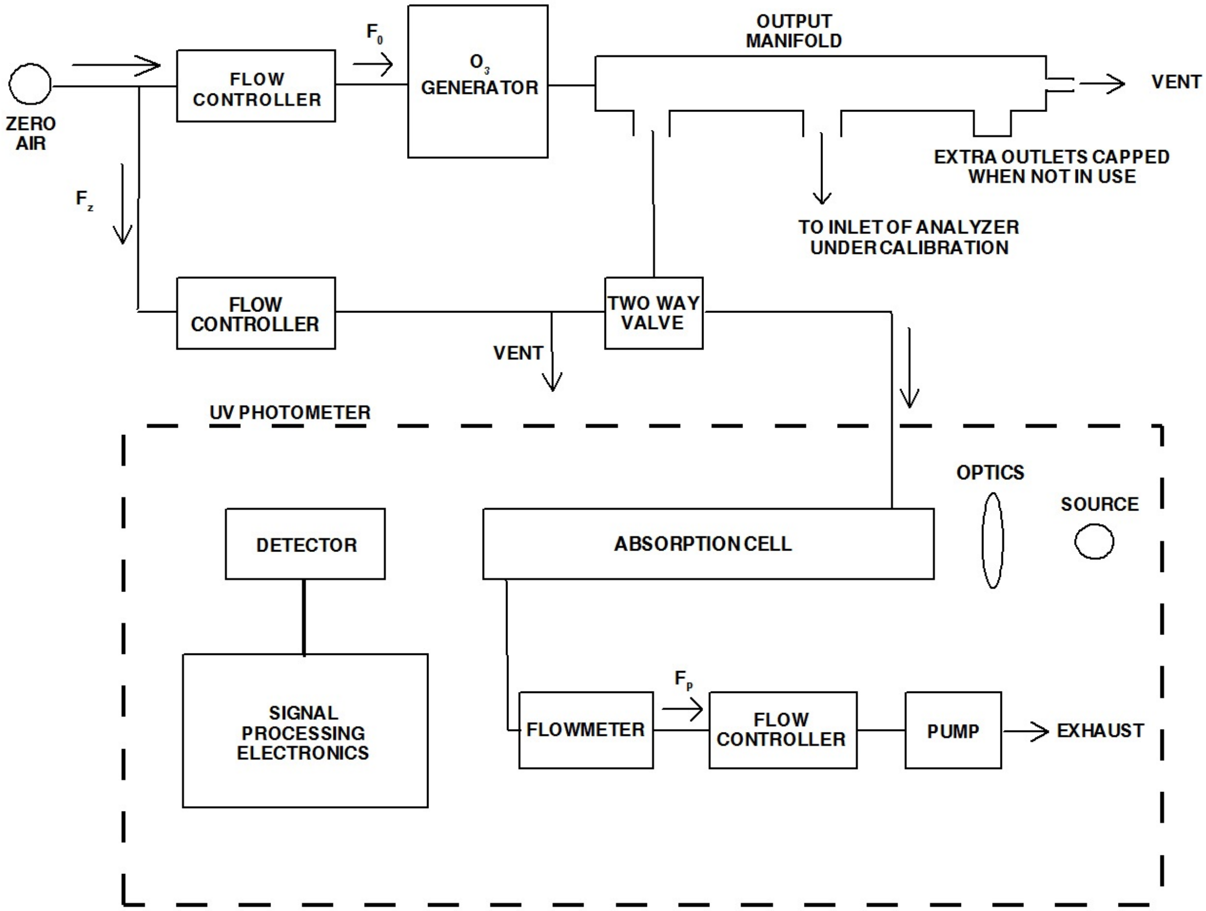

Figure 2. Schematic diagram of a typical UV photometric calibration system.

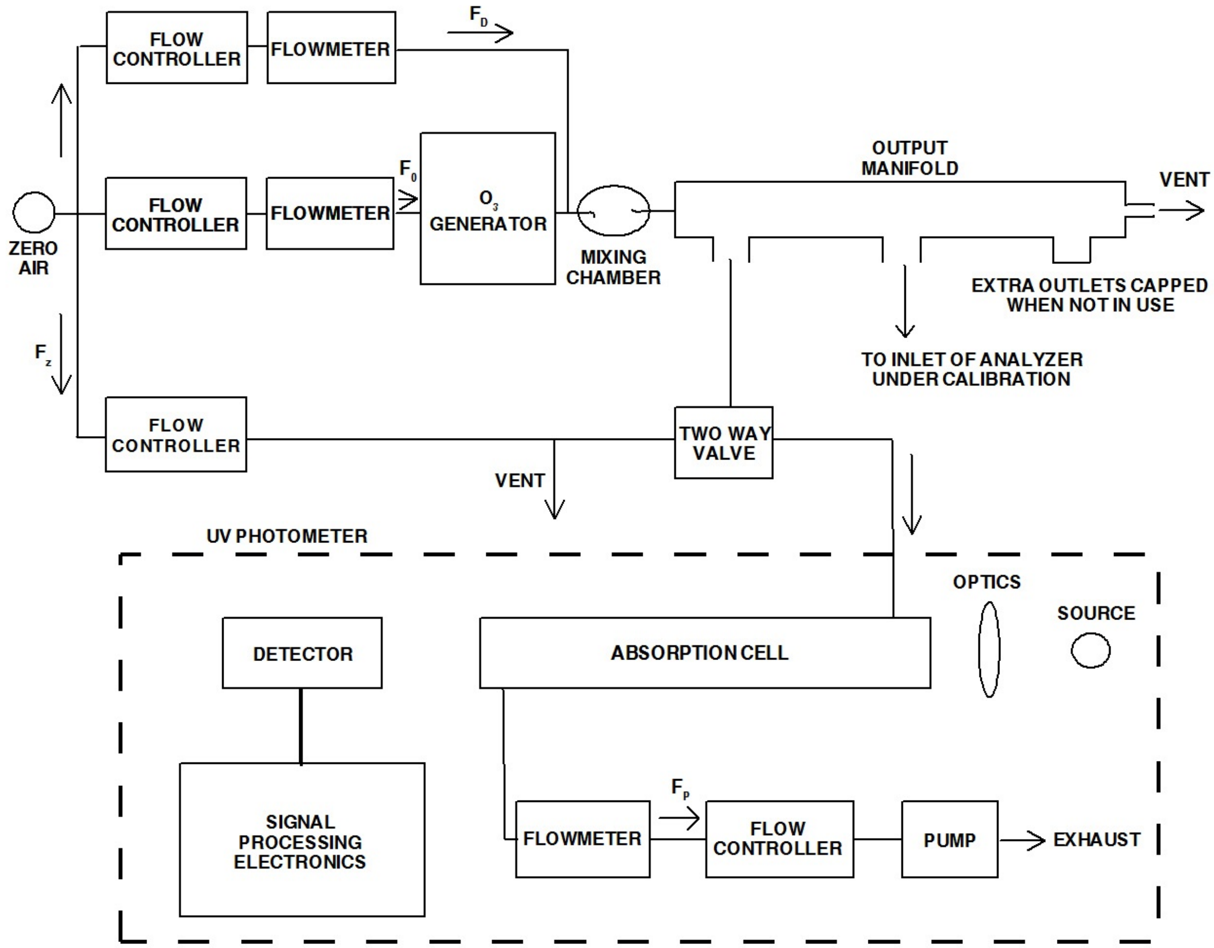

Figure 3. Schematic diagram of a typical UV photometric calibration system (Option 1).

[FR Doc. 2023-22531 Filed: 10/11/2023 8:45 am; Publication Date: 10/12/2023]