United States Environmental Protection Agency	Office of Air Quality Planning and Standards Research Triangle Park, NC 27711	EPA February, 2017
Air		

Quality Assurance Document

Quality Assurance Project Plan for the Standard Reference Photometer Program

Final
February 2017

Foreword

U.S. Environmental Protection Agency (EPA) policy requires that all projects involving the generation, acquisition, and use of environmental data be planned and documented and have an Agency-approved Quality Assurance Project Plan (QAPP) before the start of data collection. The primary purpose of the QAPP is to provide a project overview, describe the need for the measurements, and define quality assurance/quality control (QA/QC) activities to be applied to the project, all within a single document.

The following document represents the QAPP for the environmental data operations involved in EPA's Standard Reference Photometer (SRP) Program. This QAPP was generated using the following EPA monitoring and QA regulations and guidance:

- 40 CFR Part 58 Appendix A and C
- *EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans*
- *EPA QA/G-5, Guidance for Quality Assurance Project Plans*.

All pertinent elements of the QAPP regulations and guidance are addressed in this QAPP.

This document has been reviewed by all EPA Regions implementing SRPs in their respective Regions and is considered acceptable (see the following approval page).

Mention of corporation names, trade names, or commercial products does not constitute endorsement or recommendation for use.

Acknowledgments

This Quality Assurance Project Plan (QAPP) is the product of the combined efforts of the U.S. Environmental Protection Agency's (EPA's) Office of Air Quality Planning and Standards (OAQPS); and the EPA Regional Offices. The review of the material in this document was accomplished through the activities of the Ambient Air QA Community. The following individuals are acknowledged for their contributions.

EPA Regions

Region 1 - Chris St. Germain
Region 2 - Avraham Teitz
Region 4 - Mike Crowe
Region 5 - Scott Hamilton
Region 6 - Clarence Jackson
Region 7 - James Regehr
Region 8 -Joshua Rickard
Region 9 - Andy Lincoff

Office of Air Quality Planning and Standards

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ORD

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Acronyms and Abbreviations

AA-PGVP	Ambient Air Protocol Gas Verification Program
AQS	Air Quality System
CAA	Clean Air Act
CFR	Code of Federal Regulations
COC	chain of custody
DQA	data quality assessment
DQOs	data quality objectives
EDO	environmental data operation
EPA	Environmental Protection Agency
FEM	Federal equivalent method
FIPS	Federal Information Processing Standards
FRM	Federal reference method
GMIS	(NIST- Certified) Gas Manufacturer's Internal Standard
LAN	local area network
MDW	measurement data worksheet
MQOs	measurement quality objectives
NAACA	National Association of Clean Air Agencies
NAAQS	National Ambient Air Quality Standards
NIST	National Institute of Standards and Technology
NTRM	(NIST) Traceable Reference Material
OAQPS	Office of Air Quality Planning and Standards
OARM	Office of Administration and Resources Management
ORD	Office of Research and Development
PC	personal computer
PD	percent difference
PE	performance evaluation
QA/QC	quality assurance/quality control
QA	quality assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
RAVL	Regional Analytical Verification Laboratory
RD	relative difference
RPD	relative percent difference
SLAMS	state and local monitoring stations
SOP	standard operating procedure
SOW	statement of work
SRP	standard reference photometer
TAMS	Tribal Air Monitoring Services
TSA	technical system audit
WAM	Work Assignment Manager

Tables

Figures

1.0 QA Project Plan Identification and Approval

Title: Standard Reference Photometer Program Quality Assurance Project Plan

Category: 1

The attached Quality Assurance Project Plan (QAPP) for the Standard Reference Photometer (SRP) Program is hereby recommended for approval and commits the participants of the program to follow the elements described within.

Signature: Michael Papp **Date** 4/26/17

OAQPS: Mike Papp
QA Lead, OAQPS AAMG

Signature: Scott A. Moore **Date** 4/26/17

Signature: **Date** 4.18.2017

Region 1: Chris St Germain, SRP Lead

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Region 9: Andy Lincoff, SRP Lead

2.0 Table of Contents

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3.0 Distribution

A copy of this QAPP will be distributed to the SRP leads in each Regions and the CA Air Resources Board who also implement an SRP.

Since the SRP leads may change before this QAPP needs updating, the AMTIC SRP site will list the current SRP leads and can be found at https://www3.epa.gov/ttn/amtic/srpqa.html.

Regions 3 and 10 do not presently implement an SRP but are provided this documentation for their records since monitoring organization in their respective Regions will need to go to SRPs in other Regions for service.

If any personnel besides the personnel listed above implement the program, they will be trained by the personnel currently listed above on the standard operating procedure (SOPs), provided a copy of this QAPP and expected to adhere to the requirements within. Trained personnel will be documented in the SRP- Program Files. A copy of this document will be made available on AMTIC at the site listed above. The document will be reviewed annually and updated as needed. Minor modification we be made by way of a quality bulletin but minimally this QAPP will be revised and re-issued every 5 years.

4.0 Project/Task Organization

See Figure 4.1 for a graphic representation of the relationships between and among the various SRPs in the Ambient Air Monitoring Program (AAMP) Network. This section will describe how the SRP Program is organized and the roles of the various parties.

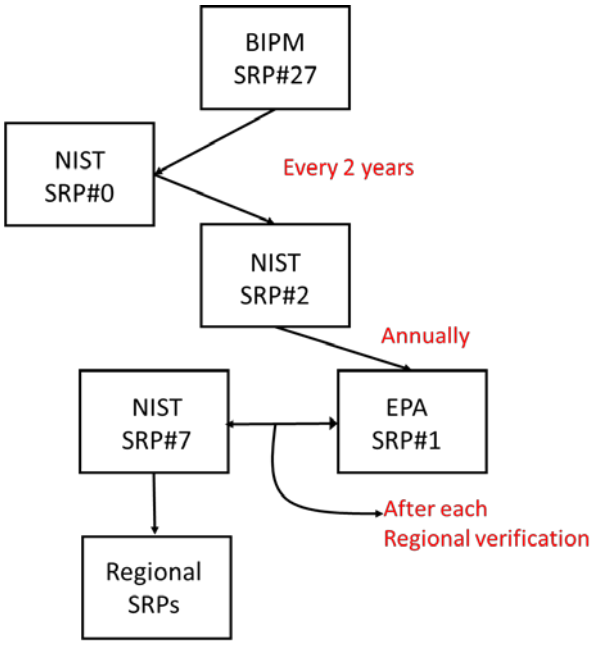


Figure 4.1 Family of Level 1 SRPs

4.1 Family of "level 1" SRPs

Figure 4.1 represents the family of Level 1 standard reference photometers. Ideally, only one Level 1 (often termed reference standard) exists for each entity to be measured. The International Bureau of Weights and Measures (BIPM)[1] maintains an SRP (#27) as the World's ozone reference standard. All EPA SRPs are now traceable to SRP #27. Each member state of the Convention of the Meter[2] has one laboratory designated to provide traceability to its country. NIST represents that laboratory for the United States. Every 2 years, NIST compares the designated U.S. National ozone reference standard (SRP #2) to SRP #27 indirectly using SRP #0. For ozone, NIST has developed a number of identical SRPs (numbered sequentially in order of date assembled) that it distributes to other countries and organizations as well as EPA. Within EPA, the EPA Office of Research and Development Metrology laboratory maintains EPA SRP #1 and #7. Each year it sends SRP #1 to NIST for verification and #7 every three years. The verification is deemed acceptable when the relationship of SRP #1 vs. SRP #2 is 1.00 $\pm$ 0.01 (slope) and an intercept of 0.0 $\pm$ 1 nmol/mol (ppbv). This relates to a bias of 1%. SRP #7 is then verified against SRP#1. Upon acceptable verification, SRP #7 is then sent to the EPA Regions to verify the SRPs operated in the Regions and used for the ambient air program. Acceptance limits for this verification are basically the same as that for #7 and #1. When SRP#7 is sent back to RTP it is compared to SRP #1 to ensure it maintains an acceptable level of data comparability. Based on this process, all transfer standards are traceable to BIPM #27. Therefore, NIST, ORD, and EPA work cooperatively to maintain the family of Level 1 SRPs for the AAMP. Figure 4.2 represents the organizational structure for the SRP Program. The lead contacts for each organization listed below can be found on the SRP Schedule for Verification and Upgrades located on AMTIC[3]. Names are not included in the QAPP since they can change at frequencies that may not be conducive to QAPP updates/revisions.

[1] http://www.bipm.org/en/scientific/chem/gas_metrology/ozone_comparisons.html
[2] http://www.speedylook.com/Convention_of_the_Meter.html
[3] http://www.epa.gov/ttnamti1/srpqa.html

National Institute for Standards and Technology (NIST). Through an interagency agreement, EPA provides resources annually to NIST to recertify SRP number 1. NIST also performs upgrades on its SRP hardware and software. It informs EPA of these advancements and provides software upgrades and either provides hardware for purchase or recommends adequate replacements.

EPA Office of Research and Development (ORD) Air Pollution Prevention and Control Division (APPCD). The lead SRP contact for APPCD can be found on the Annual Verification Schedule which is posted on AMTIC. The APPCD SRP Lead provides a number of services to the ambient monitoring community including:

- Attending any SRP Operator meetings
- Maintaining SRP #7 that travels to the EPA Regions for verification of the Regional SRPs certification
- Maintaining SRP #1 that acts as a check for #7 when it comes back in from the Regions
- Providing verification services of level 1 SRPs if Regions decide (optional) to send Level 1 SRPs to RTP
- Certifying temperature, pressure, and electrical instruments intheir metrology laboratory for use in diagnostic checks on the SRP
- Providing verification services of level 2 transfer standards when asked and time permits
- Upgrading the regional SRPs as needed. This sometimes can be handled by the Regional SRP operators but in some cases the regional SRP will be sent back to Research Triangle Park (RTP) for the work to be performed in the APPCD laboratory
- Coordination with NIST to provide funding for annual SRP #1 verifications and any hardware /software needed
- Providing training on SRP verifications as needed
- Coordination with OAQPS on funding for the SRP Program and to provide results of verifications on an annual basis. Verification data are stored on EPA-RTP servers and access is provided to OAQPS
- Maintaining/revising the Annual Verification Schedule

EPA Regional Offices. The EPA Regional Offices roles include:

- Coordinating the delivery of SRP#7 with OAQPS and APPCD
- Timely verification of Regional SRP with SRP #7 and shipment back to APPCD
- Submission of SRP to SRP verification results to OAQPS
- Scheduling SRP level 2 verifications with monitoring organizations
- Following SRP SOPs for verification of level 2 transfer standards
- Providing verification results to monitoring organization and filing results at regional level

EPA OAQPS- OAQPS has overall technical oversight responsibilities for the SRP Program. OAQPS roles include:

- Developing the QAPP and SOPs with the assistance of APPCD and the EPA Regions
- Posting and updating the Annual Verification Schedule on AMTIC[4]
- Scheduling quarterly SRP conference calls
- Providing funding for the maintenance, upkeep, and shipping of the SRPs
- Providing funding for NISTs' annual verifications
- Coordinating SRP to SRP verifications with ORD on a shared server
- Coordinating SRP Workgroup

SRP Workgroup. The SRP Workgroup is made up of the entities described above and meet annually or when necessary to address technical issues with the program. This SRP Program has been implemented for many years and has not changed significantly in that time period. Therefore, there are not many "new" issues that arise and those that do are usually related to software or hardware upgrades. Workgroup meetings will be used to develop annual SRP to SRP schedules, any procedural modifications and new training activities.

Monitoring Organizations. The monitoring organizations are required to provide a level 2 transfer standard (see Section 5) for verification against the level 1 standard on an annual basis. Guidance on the theory and process behind the implementation of the transfer standards can be found in the document titled: *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone*[5]. Regional SRP operators will conduct the verification and provides results to the monitoring organizations.

[4] http://www.epa.gov/ttnamti1/srpqa.html
[5] http://www.epa.gov/ttnamti1/qapollutant.html

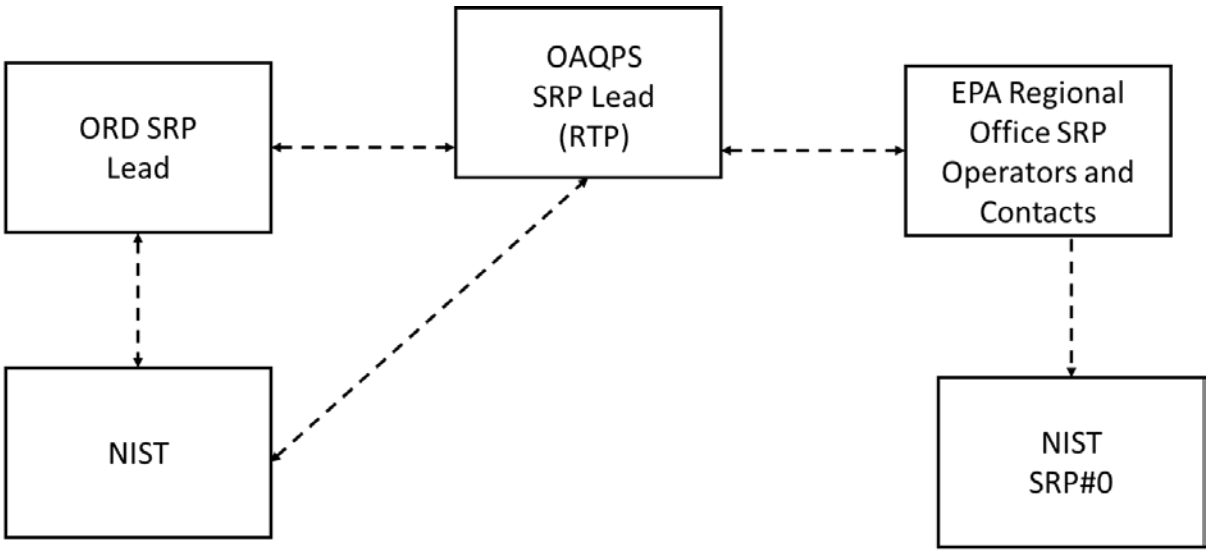


Figure 4.2 SRP Program Structure

5.0 Problem Definition/Background

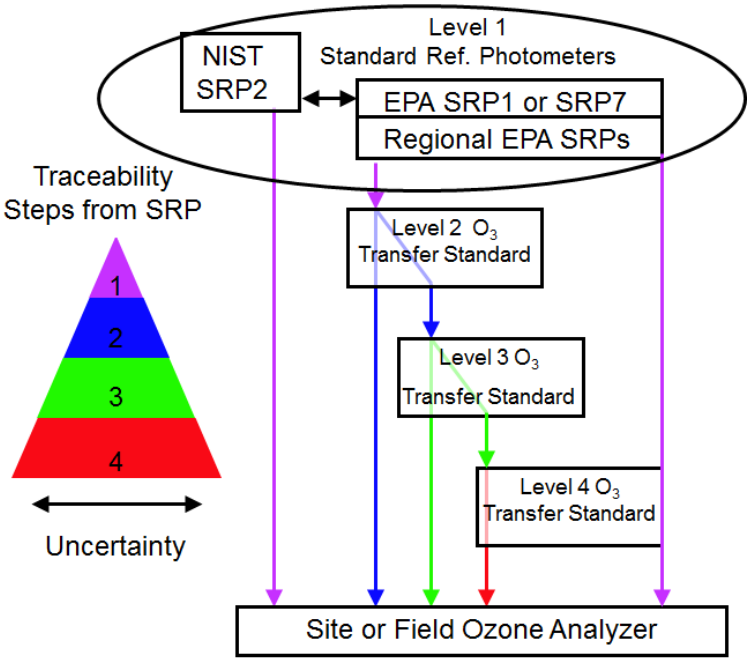


Figure 5.1. Ambient air ozone traceability scheme

In ambient air monitoring applications, precise ozone concentrations called standards are required for the calibration of ozone analyzers. Gaseous ozone standards cannot be stored for any practical length of time due to the reactivity and instability of the gas. Therefore, ozone concentrations must be generated and "verified" on site. When the monitor to be calibrated is located at a remote monitoring site, it is necessary to use a transfer standard that is **traceable** to a more authoritative standard. **Traceability** is the "property of a measurement result whereby the result can be related to a stated reference through a documented unbroken chain of calibrations**,** each contributing to the measurement uncertainty" [1] (ISO).

A transfer standard is defined as a transportable device or apparatus which, together with associated operational procedures, is capable of accurately reproducing pollutant concentration standards or of producing accurate assays of pollutant concentrations which are quantitatively related to a higher level and more authoritative standard. The transfer standard's purpose is to transfer the authority of a Level 1 pollutant standard to a remote point where it is used to verify or calibrate an air monitoring analyzer.

Transfer standards may be used for many different purposes. In this document, however, the discussion of transfer standards for ozone (O3) applies to the family of standards that are used beyond standard reference photometers or Level 1 standards. This document identifies the family of standard reference photometers (SRPs) as Level 1 standards. Beyond the SRPs, all standards will be considered transfer standards and will be numbered (starting with 2) based on its "distance in the traceability chain" from a verification against a Level 1 standard.

[1] International Standards Organization (ISO)- International Vocabulary of Basic Terms in Metrology

A claim of traceability requires three elements:

1. a declaration of the source of traceability (*e.g.,* NIST),
2. a full description of the traceability chain from the source to the measurement of interest, and
3. an uncertainty claim with supporting data. The responsibility for providing support for an uncertainty claim rests with the entity making the claim (*i.e.,* the provider), but the responsibility for assessing the validity of such a claim rests with the consumer.

Figure 5.1 represents the scheme that will be employed to ensure that the use of ozone transfer standards are applied in a manner that will ensure a specified level of measurement uncertainty and traceability. **Measurement uncertainty** describes a region about an observed value of a physical quantity which is likely to enclose the true value of that quantity. Measurement uncertainty is related with both the systematic and random error of a measurement, and depends on both the bias and precision of the measurement instrument. At each measurement phase (e.g., levels in Fig. 5.1) errors can occur, that in most cases, are additive.

The goal of this QAPP is to describe the quality system requirements to conduct the traceability steps 1 and 2:

1. Level 1 SRP #7 to Regional SRP Verification
2. Regional SRP to monitoring organization Level 2 transfer standard.

6.0 Project/Task Description

The purpose of this element is to provide a background of the types of activities to be conducted, the measurements that will be taken and the associated quality assurance/quality control (QA/QC) goals, procedures, and timetables for collecting the measurements. Due to the nature of the verification activity, OAQPS has identified a Category 1 QAPP for this program.

The goal of this project is to verify that the Regional SRPs operating in the AAMP network are within the acceptance limits explained below and identified in section 7. It conforms to 40 CFR Part 58 Appendix A which requires that test concentrations for ozone (O3) must be obtained in accordance with the ultra violet photometric calibration procedure specified in 40 CFR Part 50 Appendix D, or by means of a certified O3 transfer standard. This process has been deemed to meet the acceptance requirements for certifying transfer standards.

6.1 Description of Work to be Performed

The following activities will occur each year but not necessarily on a calendar year basis:

- The SRP Workgroup will meet (face to face or via conference call) on a quarterly basis to:
  - Discuss general issues/updates in the program,
  - discuss necessary funds for the year to include upgrades, repairs, and NIST verification. OAQPS will secure funds each year, and
  - set up the SRP # 7 regional delivery and upgrade schedule (if upgrades necessary). This schedule will be posted on SRP site on AMTIC[1]
- APPCD will work with NIST to transfer both SRP#7 (every 3 years) and SRP #1 (every year) to NIST for re-verification. NIST will verify #1 and #7 and provide results to APPCD and OAQPS.
- APPCD will ship SRP#7 to the Regional Offices for SRP to SRP verifications. The Regions will verify their SRP against #7 using the SRP SOPs (also on SRP AMTIC site) and provide verification data to OAQPS SRP Lead.
- APPCD will receive SRP #7 back from Regions and check it against SRP#1 at frequencies described in the quality control section.
- Regional offices will schedule SRP to level 2 transfer standard verifications with monitoring organization and follow SRP SOPs for verifications. Verification results will be provided to the monitoring organization and stored in the Regions SRP Verification database.

[1] http://www.epa.gov/ttnamti1/srpqa.html

6.2 Measurements Expected

The SRP program is fairly straight forward. The process entails the generation of an ozone concentration from the authoritative instrument and comparing this value to the measure concentration of the instrument being verified. The measurements expected will be similar for SRP to SRP verifications versus SRP to Level 2 standards but will be discussed separately.

6.2.1 SRP #7 to Regional SRP Re-Verification.

The SRP#7 comparison is accomplished by averaging 10 points per concentration with a minimum of 12 concentration points, which includes a zero at the start and at the end each re-verification run. (see Figure 9.7.19.1 Verification Control Box in the SRP SOP). Each of these individual concentration sets (or re-verification run) is considered a cycle in the SRP Control Software. At a minimum, the SRP comparison will consist of 3 cycles (approximately 2 hours per cycle). For an acceptable comparison, the average of all the cycles, the regression slope must be 1.00 $\pm$ 0.01 and the intercept must be $\pm$ 1ppb.

6.2.2 SRP to Level 2 Standard Re-Verifications

The SRP comparison is accomplished by averaging 8 stable readings for each concentration point. There should be a minimum of 6 concentration points and a zero at the start and at the end of each cycle. This is considered a cycle. At a minimum, the SRP comparison will consist of three cycles (approximately 1 hour per cycle). For an acceptable comparison, the average slopes of all the cycles are $<\pm$ 3ppb and the intercept must be 0 $\pm$ 3ppb . There is a separate standard operating procedure (SOP) for this comparison so it is not discussed in any detail in this QAPP. Table 7-1, which summarizes the transfer standard acceptance criteria, includes this comparison as a "Re-Verification" to the SRP" and should not be misconstrued as an "initial 6x6 verification" (discussed below).

6.2.3 SRP to Level 2 "6x6" Verification

Upon initial receipt of a new transfer standard that will be designated as a level 2 standard, or a level 2 standard that has undergone repair, a "6x6" verification is required. The verification requires the averaging of 6 comparisons between the transfer standard and a level 1standard. Each comparison must cover the full range of O3 concentrations (6 concentrations) and is to be carried out on different days (6 days). The process is the same as described in 6.2.2 with the exception of carrying the process out over 6 days. This process is more fully described in Section 4 of the document *Transfer Standards For The Calibration of Ambient Air Monitoring Analyzers*[2]. This document is considered a reference to this QAPP and does not need to be

[2] http://www.epa.gov/ttnamti1/qapollutant.html

repeated in this document. A new Level 2 standard or one that was adjusted or repaired would also be expected to undergo an initial 6x6 verification with an SRP. Using a Level 2 Standard to perform a 6X6 verification of another Level 2 Standard is discouraged

6.3 Personnel

Personnel performing this work will be federal EPA personnel or personnel working under EPA contracts. Personnel performing this work will be federal EPA personnel or personnel working under EPA contracts. A working knowledge of the SRP and the various Level 2 standards that arrive for verification are needed to conduct this work. SRPs have been operated out of the Regional laboratories for many years and training is passed down from operator to operator with the use of the SRP-SOPs. However, operators must be able to demonstrate proficiency and overall understanding of the SRP system. When necessary the APPCD will provide training for new operators.

6.4 Equipment

Figure 6.1 demonstrates a set-up of the SRP in a laboratory setting**.** Each SRP consists of a separate optical bench SRP Photometer and two instrumentation modules (electronics and pneumatics).

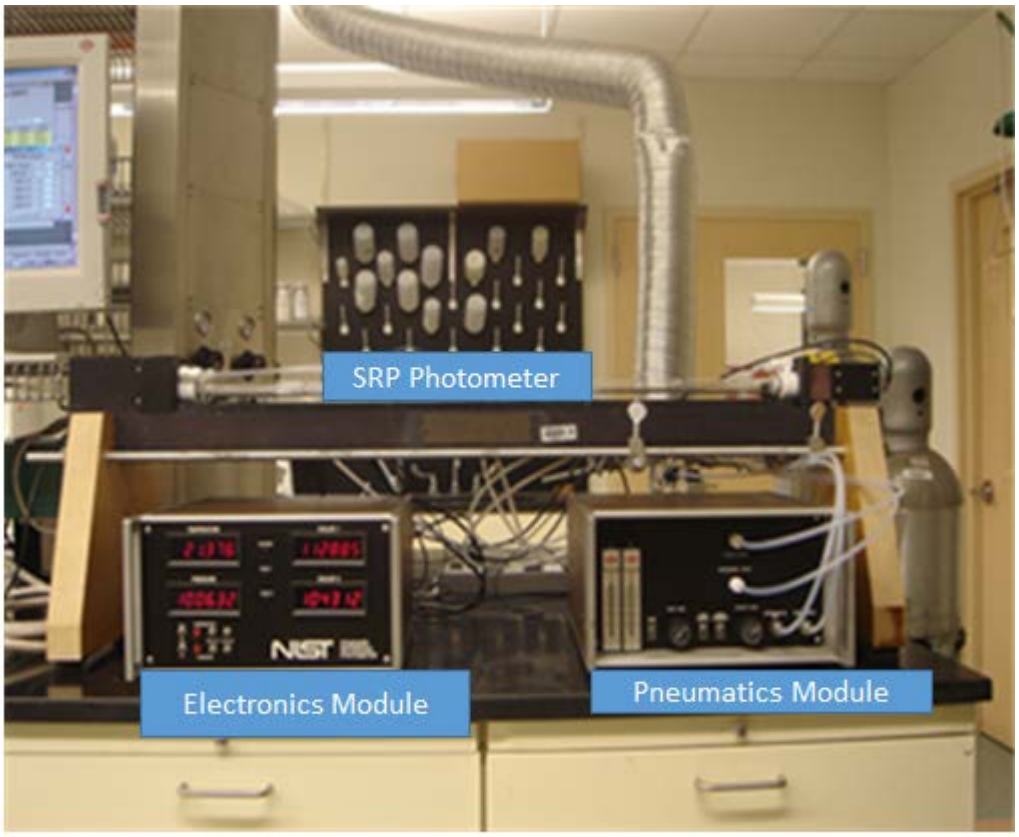


Figure 6.1 SRP Basic Equipment

In addition, the system requires:

- SRP isolation power transformer. (optional)
- Computer with optional printer
- SRP Control Program for WindowsXP Service Pack 3
- Zero grade air generator capable of supplying clean air at 35 pounds per square inch (psi) and 30 liters per minute (LPM)
- Teflon tubing
- NIST traceable barometer, for lab pressure reading.
- NIST traceable thermometer, for lab temperature reading
- Agency server for reliable data storage

7.0 Data Quality Objectives and Criteria for Measurement

The purpose of this element is to document the DQOs of the project and to establish performance criteria for the environmental data operation (EDO) that will be used in generating the data.

7.1 Data Quality Objectives

DQOs are qualitative and quantitative statements derived from the DQO process that clarify the monitoring objectives, define the appropriate type of data, and specify the tolerable levels of decision errors.

As indicated in 40 CFR Part 58 Appendix A:

2.6.2 Test concentrations for ozone (O_3) must be obtained in accordance with the ultra violet photometric calibration procedure specified in appendix D to part 50 of this chapter, or by means of a certified O_3 transfer standard.

At present, all monitoring organizations calibrate ozone analyzers using a certified transfer standard. The SRP Program provides traceability for the standards used by monitoring organization to calibrate ozone analyzers.

Since the first environmental data operation is to establish traceability among the family of Level 1 SRPs, the data quality objective for a Level 1 (host) to Level 1 (guest) comparison is:

Regression slope = 1.00 + 0.01 and intercept <+ 1 ppb

This estimate is based on an SRP to SRP comparison of three cycles, by averaging 10 points per concentration with a minimum of 12 concentration points, which includes a zero at the start and at the end each verification run. The host standard is considered the authoritative standard. Relative to this QAPP, SRP #7 is considered the host and the Regional SRP is considered the guest.

The second environmental data operation is to establish traceability of the Level 1 Regional SRP to the Level 2 standards brought in by the monitoring organizations. There are two checks that may be accomplished.

Initial 6 x 6 verification = RSD of six slopes 3.7% Std. Dev. of six intercepts 1.5
Reverification = Average slope of each individual point difference $\leq \pm$ 3%

The initial 6 x 6 evaluation is described in the document *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone*[1], and helps to establish the accuracy and repeatability of the Level 2 standard over a six-day period. Once the Level 2 standard passes the 6x6 verification, in subsequent years it will undergo an annual reverification with a minimum of 6 upscale

[1] http://www.epa.gov/ttnamti1/qapollutant.html

concentration points (plus zero at start and end) with each concentration point replicated 7 times.

7.2 Proposed Measurement Quality Objectives for Precision and Bias Data Quality Indicators

Based upon the criteria above, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement quality objectives (MQOs) are designed to evaluate and control various phases of the measurement process to ensure that total measurement uncertainty is within the range recommended by the DQOs. The MQOs can be defined in terms of the following data quality indicators:

Precision—A measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error. Replication of individual concentration points can be used to assess precision.
Bias—The systematic or persistent distortion of a measurement process, which causes error in one direction. Bias will be determined by estimating the positive and negative deviations from the true value as a percentage of the true value. Comparison of the authoritative SRP (host) to the subordinate SRP or transfer standard (guest) identifies acceptable or unacceptable levels of bias.
Representativeness—A measure of the degree in which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Since the SRP Program is a quality control technique, its goal is to ensure that the transfer standards can provide reliable concentrations of ozone to ozone monitors to ensure they are within calibration acceptance requirements. In that regard, testing of these standards are made across the operating ranges all Federal Reference Method (FRM) ozone monitors and from that respect they provide representative concentrations even though ambient air concentrations of ozone will rarely extend to the instruments operating range.
Detectability—The determination of the low-range critical value of a characteristic that a method-specific procedure can reliably discern. Transfer standards are tested at low concentration ranges and help establish that the analyzers that use the transfer standards are linear at these low concentrations.
Completeness—A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Since the SRP verifications are accomplished in a controlled laboratory setting, a goal of 90% completeness is established.
Comparability—A measure of confidence with which one dataset can be compared to another. By use of the same SOP/QAPP, and the traceability of all SRPs to a common SRP, the SRP Program is able to ensure the comparability of SRP devices between the Regional laboratories.

In order to achieve acceptable verification results, a number of checks must be made to the SRP. Table 7-1 provide a description of the checks, their frequency, acceptance criteria and the section of the SRP-SOP where they can be found.

Table 7-1 Summary Specifications for the Family of Ozone Standards.

Requirement	Frequency	Acceptance Criteria	Information /Action
Level 1 Traveling SRP to Regional Level 1 SRP			
Verification Procedure	1/year (3 evaluation cycles of 10 concentrations and zero)	Regression slope = 1.00 ± 0.01 and intercept <± 1 ppb	Usually at a Regional Office and compared against the traveling EPA SRP
SRP & STOLAB Calibrator Warm Up Time	Every Verification	SRP> 8 hour STOLAB > 15 minutes	SOP Section 4.2.4
Verification for Zero Air	Once a year (annual maintenance) or if there is a suspected problem.	0 ± 0.2 ppb	SOP section 4.3.8. Check against zero air tank
Temperature Check	Every Verification	**STEP 1**: > 0.0 mV and <1.0mV **STEP 2:** 300.0 mV ± 0.1 mV or 1000.0 mV ± 0.1 mV **STEP 3:** >0.0 mV and <1.0 mV **STEP 4:** 30°C (or 100°C) ±0.01 All 4 steps must pass	SOP section 4.2.5
Pressure Check	Every Verification 1) from lab standard 2) in CAL position	1) ± 0.2 mb 2) ± 0.1 mb from 700.0 mb	SOP Section 4.2.6
Source lamp and O3 generator lamp temperature	Every Verification	Readings with ± 0.1° C (of Watlow set point) actual temperature setting will vary from SRP to SRP	SOP Section 4.2.7
Scaler Counts	Every Verification	Scaler 1: >100,000 and <250,000 Scaler 2: >80,000 and <250,000	SOP Section 4.2.8
Dark Counts	Every Verification	>5 and <25 counts	SOP Section 4.2.9
Stability Test	Every Verification	Last 3 < 0.000030 Ratio Std Dev of Scaler1 and Scaler2 Last 3 < 15	SOP section 4.1.10
Volt Meter-Certification	1/year	Resolution of at least 0.1 mV	
STOLAB Certification	1/year		
Lab Pressure Standard Certification	1/year by manufacturer or ISO 17025 Accredited Lab		
Level 1 Regional SRP to Level 2 Transfer Standard			
Verification (6x6) One per day over six days 6 concentration points Zero before and after Average 7 points per concentration.	After qualification (we do not do qualifications any more) see SRP SOP 5.2 and for new units or any unit after major repairs.	RSD of six slopes 3.7% Std. Dev. of 6 intercepts 1.5 and Slope of 1.00 +/- 3% and Intercept of 0 +/- 3ppb	Transfer Standard Doc EPA-454/B-10-001 Section 4.1 SOP

Requirement	Frequency	Acceptance Criteria	Information /Action
Re-Verification Total of three cycles on 1 day 6 concentration points Zero before and after Average 7 points per concentration.	After qualification and upon receipt/adjustment/repair 1/year	Average slope of each individual point difference $\leq \pm$ 3%	Level 2 standard usually transported to EPA Region's SRP for comparison
SRP & STOLAB Calibrator Warm Up Time	Every Verification	$\geq$ 4 hour preferably overnight for SRP STOLAB >15 min	5.1.4
Verification for Zero Air	Annually or as needed.	0 ± 0.2 ppb	SOP section 4.3.8. Check against zero air tank
Temperature Check	Every Verification/Re-Verification	**STEP 1**: > 0.0 mV and <1.0mV **STEP 2:** 300.0 mV ± 0.1 mV or 1000.0 mV ± 0.1 mV **STEP 3:** >0.0 mV and <1.0 mV **STEP 4:** 30°C (or 100°C) ±0.01 All 4 steps must pass	Take corrective action (see SOP)
Pressure Check	Every Verification/Re-Verification 1) from lab standard 2) in CAL position	1) $\geq \pm$ 0.2 mb 2) ± 0.1 mb from 700.00mb	SOP Section 5.1.1.6
Source lamp and O3 generator lamp temperature	Every Verification/Re-Verification	Readings with $\pm$ 0.1° C of each other	SOP Section 5.1.1.7
Scaler Counts	Every Verification/Re-Verification	>100,000 and <250,000	SOP Section 5.1.1.8
Dark Counts	Every Verification/Re-Verification	>5 and <25 counts	SOP Section 5.1.1.9
Stability Test	Every Verification/Re-Verification	Last 3 < 0.0003 Ratio Std Dev dstab131 or other Last 3 < 15 Count ratio	SOP section 5.1.1.10
Volt Meter-Certification Resolution of at least 0.1 mV	1/year	To be based on the instrument certifying laboratory (NIST Traceable or ISO 17025 accredited)	
Lab Temperature Standard Certification resolution of $\pm$0.1°C	1/year	To be based on the instrument certifying laboratory (NIST Traceable or ISO 17025 accredited)	
Lab Pressure Standard Certification Resolution of at least 0.1 mbar	1/year	To be based on the instrument certifying laboratory (NIST Traceable or ISO 17025 accredited)	

Information in red are not acceptance criteria they are the criteria upon which one chooses a standard.

8.0 Special Training Requirements/Certification

For this project, no special training requirements or certifications are required. Each new EPA SRP operator gets training from the ORD SRP lead, if possible, at the new operator's location. The SRP SOP is the basis of the training. The training will be documented in a certificate, with dates of the training, including hours involved, trainer and trainees name(s), and the training location (see Section 9). This information will be posted on the EPA QA SharePoint Site.

The training will include the comparison of the Regional SRP to the RTP SRP (#7). The training will also include an initial verification of a monitoring agency's level 2 standard.

If the ORD lead is not available, very experienced EPA Regional SRP operators can provide the training. A final alternative is sending the new operator to NIST, when the NIST SRP lead is available.

9.0 Documentation and Records

The purpose of this element is to define the records critical to the project, the information to be included in reports, the data reporting format, and the document control procedures to be used.

A document, from a records management perspective, is a volume that contains information, which describes, defines, specifies, reports, certifies, or provides data or results pertaining to environmental programs. As defined in the *Federal Records Act of 1950 and the Paperwork Reduction Act of 1995* (now 44 U.S.C. 3101-3107), records are: "...books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the U.S. Government under Federal Law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them..."

The following information describes the document and records procedures for the SRP Program. In EPA's QAPP regulation and guidance, EPA uses the term "reporting package," which will be defined as all of the information required to support the concentration data reported to EPA. This information includes all data required to be collected, as well as data deemed important by the SRP Program.

9.1 Documents and Records for SRP Network

The following documents will be kept by the OAQPS and ORD SRP leads:

- Paper and electronic SOPs and the QA Project Plan
- SRP vs SRP comparison records/reports,
- Equipment/service purchases, and maintenance/repair records/logbooks, are kept in RTP, NC, where they are generated or sent by NIST or the EPA Regions to RTP. For example, the comparisons of one or both of the 2 RTP SRPs against the NIST-located SRPs are provided by NIST to RTP. These records will also be archived.

The OAQPS and ORD SRP leads will keep these records and reports on an ORD server as described in Section 9.2. In addition, the SOP, QAPP, and Level 1 verifications will also be archived on the Ambient Air QA Program SharePoint site in the SRP Program file.

Similarly, SRP Program records and reports generated or sent to the Regional SRP operators are kept as required by EPA in the offices of the Regional SRP operators, and the reports are kept by the agencies that Regional operators are conducting the comparisons for.

Since Regions 3 and 10 do not have SRPs, the records and reports of the Region 3 and 10 state and local agencies that sent their primary ozone standards to Regions 2 and 9, respectively, may be kept by the "comparing" and the "home" Regions, and by the state or local agencies.

In addition, it should be said that Region 10 has been primarily- or entirely- having its standards (those state primary ozone standards to the CA ARB ozone SRP operator in the Sacramento CA labs of CA ARB, and not to the SRP in the EPA Region 9 labs in Richmond, CA.

9.1.1 Data Reporting Package

All information that is sent to RTP for the SRP for a particular year will be filed using the following file naming convention.

1. Program Identifier: SRP
2. SRP Serial Number[1]: (i.e., 06 is the identifier for the Region 5 SRP)
3. Year: YYYY

As an example the file structure for the Region 5 SRP whether in the Region, or in RTP would be "SRP-06_2014" for calendar year 2014.

The SRP files will be further separated into functional areas as shown in Table 9-1. Section 19 lists the raw data that will be collected, saved and archived for the SRP. Table 9-1 provides the documents and records that will be kept for the program.

Table 9-1 SRP File Structure

Program Identifier	**SRP**	
SRP S/N		
Year		
SRP File Code	**Category**	**Record/Document Types**
Function		
PM	**Program Management Files**	Policy Memorandum

[1] Serial numbers for all SRPs in the ambient air program can be found on the AMTIC website at http://www.epa.gov/ttnamti1/srpqa.html

Program Identifier	SRP	
SRP S/N		
Year		
SRP File Code Function	Category	Record/Document Types
CO	**Communications Files**	Telephone record and e-mail communication between: • RTP- ORD and OAQPS • Monitoring Orgs • Other
QA	**Quality Assurance Files**	SRP QAPP Instrument and Standard Certifications QA/QC Check Reports Data validation summaries
TE	**Technical Files**	Standard operating procedures (SOPs) Documentation of instrument inspection and maintenance Laboratory notebook Calibration Records Procurement logs Inventories of capital equipment, operating supplies, and consumables Repair and maintenance (e.g., service records)
DF	**Data Files**	SRP-SRP verifications (Annual) SRP-Level 2 (by Quarter)
RE	**Reports**	Verification Reports (by Quarter) Journal articles/papers/presentations
TR	**Training**	Training audit document Training materials

As an example, in 2014 SRP-36 received a verification from 3/11-3/13/2014 this data would be stored in "SRP_36_2014_DF_SRP-SRP"

It is suggested that the Regions follow a similar structure but the structure above is not a requirement.

9.1.2 Notebooks

Laboratory notebooks- will be uniquely numbered and be associated with each SRP instrument. The notebook will be used to record calibration dates, analytical runs, routine maintenance information and any information that may support a particular analytical run.

Laboratory Binders- Three-ring binders will contain inspection and maintenance forms and SOPs.

9.1.3 Electronic Data Collection

All data for re-verifications, verifications or calibrations (also referred to as cycles) are automatically entered into an Excel spreadsheet. The SRP can record up to three different guests at the same time and all raw data is recorded into these spreadsheets. After the required number of cycles have been completed the start time, end time, date, file name, guest instrument identification information, slope, intercept, R2 and average of each concentration point are linked to a summary report. The critical elements are evaluated and then the spreadsheet will automatically evaluate and display a PASS/FAIL decision for the dataset (see Figure 14.2).

More details about this process can be found in Element 18.0, *Data Acquisition Requirements*, and Element 19.0, *Data Management*.

Various hard copies are created from electronic systems, such as reports and spreadsheets used by the NIST SRP lead, EPA ORD-APPCD, Regional SRP operators, and others. Hard copies that are determined to be permanent record (e.g., data that lead to significant findings or conclusions) will be filed as a data reporting package to ensure that all SRP Program data are properly archived.

9.1.4 Hand-Entered Data

There will be some data forms that will be entered by hand. These can be found in the SRP SOPs. All hard copy information will be completed in indelible ink. Corrections will be made by inserting one line through the incorrect entry, initialing this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line.

9.1.5 E-mail and Attachments

OAQPS, ORD-APPCD, and the Regional SRP operators will create file folders for SRP Program Correspondence. Personnel participating in the program will save any emails that they consider important to the project either in relation to changes/revisions to the Implementation Plan/QAPP/SOPs, changes to analysis timelines and correspondence among monitoring organizations and producer participants.

9.2 Data Reporting Package Archiving and Retrieval

The information discussed above will be retained for 4 years, and it is based on a calendar year (i.e., all data from calendar year 2009 will be archived until 12/31/2013). Upon reaching the 4-year archival date, hardcopies records can be disposed of. Electronic data will be maintained in archive indefinitely.

10.0 Sampling Design

The purpose of this element is to describe all of the relevant components of the SRP sampling design, the key parameters to be estimated, the number and types of samples to be expected, and how the samples are to be collected. In order to provide efficiencies and avoid redundancies:

- Section 5 described the background of the program and identified the requirement in 40 CFR Part 58 Appendix A, and
- Section 6.0 details the critical time lines and activities for the SRP Program.

10.1 Rationale for the Design

The rationale for the implementation design for the SRP Program is to establish traceability and acceptable measurement uncertainty (as defined in Table 7-1) across all ozone transfer standards used in the AAMP.

Each year, EPA will establish traceability of Level 1 ozone standards from NIST through a process whereby all Regional SRPs will be verified by the RTP traveling SRP #7 or #1. This process ensures traceability and comparability among the family of Level 1 SRPs. Due to the number of Level 1 standards in the Regions, the fact that the Level 1 standards are very stable and the traveling standards come back to RTP for re-verification, verification at higher frequencies are not needed and could not be accomplished without additional Level-1 SRPs.

The second step in this process provides traceability to the monitoring organizations Level 2 transfer standards through an annual verification (as defined in Table 7-1). Often, this Level 2 standard will be located at the monitoring organizations laboratory. From there, Level 3 transfer standards that are transported to the field can be verified every 6 months (or beginning and end of ozone season). The verification of Level 3 and higher standards are beyond the scope of this QAPP and can be found in the document *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone* [1].

[1] http://www.epa.gov/ttnamti1/qapollutant.html

11.0 Sampling Methods Requirements

This QAPP is strictly for describing the quality system requirements for the SRP to SRP Level #1 verifications and the SRP to Level 2 verifications. Therefore, there is no ambient air sampling and therefore no ambient air sampling methods required in this program beyond the SRP SOP listed on AMTIC and referenced in this QAPP.

12.0 Sample Handling and Custody

This QAPP is strictly for describing the quality system requirements for the SRP to SRP Level #1 verifications and the SRP to Level 2 verifications. Therefore, there is no sampling and therefore sample handling and custody are not required.

Although there is no chain of custody in this process it is extremely important that the traveling SRP (Level 1) and Level 2 standards are handled with care. The SRP-SOPs provide for the unpacking and packing of the traveling SRP. In many cases, the Level 2 transfer standards are brought to the Regional SRP labs by the monitoring organizations. If so, they are unpacked by the monitoring organization representative. If not, SRP operators will carefully unpack the instruments and note if any damage has occurred in transit. If damage has occurred, it will be immediately reported to the monitoring organization as well as a determination if the damage can be repaired and whether a verification can be implemented.

13.0 Analytical Methods Requirements

The SRP Program will follow the procedure *Standard Operating Procedure (SOP) for the Verification and Re-verification of EPA's Ozone Standard Reference Photometers*. This document is on the SRP website on AMTIC[1]. Since SOPs may change more frequently than the QAPP, it is not included in this document.

The procedure is used to verify both the regional SRPs against the traveling SRP (with the traveling SRP called the "host" SRP), as well as the verification of the Regional SRP to the monitoring organizations Level 2 standards (in this case the Regional SRP is considered the "host").

The SOP will be followed as written unless:

- Changes in the SOP are required
- TSAs uncover findings that need correction to the method.
- New instrumentation requires a change.

Regions or the ORD SRP contact will notify the EPA RTP SRP Lead if a change is needed. After discussion with ORD and the Regions, if a change is needed to improve data quality, it will be instituted immediately and a record, in the form of a quality bulletin (see Fig. 13.1), will document the reason for the change, and the affect it had on verifications prior to the change. An addendum will be made to the SOP that will cover the change until there is time for the SOP to be revised (within one year of identification). Changes that do not effect the quality of data but are either grammatical in nature or provide an alternate acceptable procedure will be made on a less frequent basis.

[1] http://www.epa.gov/ttnamti1/srpqa.html

Quality Bulletin

Subject:

Number _____
Date _____
Page _____of _____
Supersedes No. _____
Dated _____

Replace and Discard Original

Add Material to Document

Notes:

_____
SRP QA Coordinator

Retain this bulletin until further notice ☐
Discard this bulletin after noting contents ☐
This bulletin will be invalid after (Date) _____ ☐
This bulletin will be incorporated into quality ☐
Procedure No. _____ by (Date) _____ ☐

Figure 13.1. Quality bulletin

14.0 Quality Control Requirements

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad QA activities, such as establishing policies and procedures, developing DQOs, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific QC procedures, such as audits, calibrations, checks, replicates, and routine self-assessments. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data.

QC is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that the stated requirements established by the customer are met. In the case of the AAMG, QC activities are used to ensure that measurement uncertainty, as discussed in Section 7, is maintained within acceptance criteria for the attainment of the DQO.

14.1 QC Procedures

There are basically two facets of the program that are important to control verification, and information collection/assessment/reporting. Each will briefly be discussed below.

14.1 Verification (Analysis)

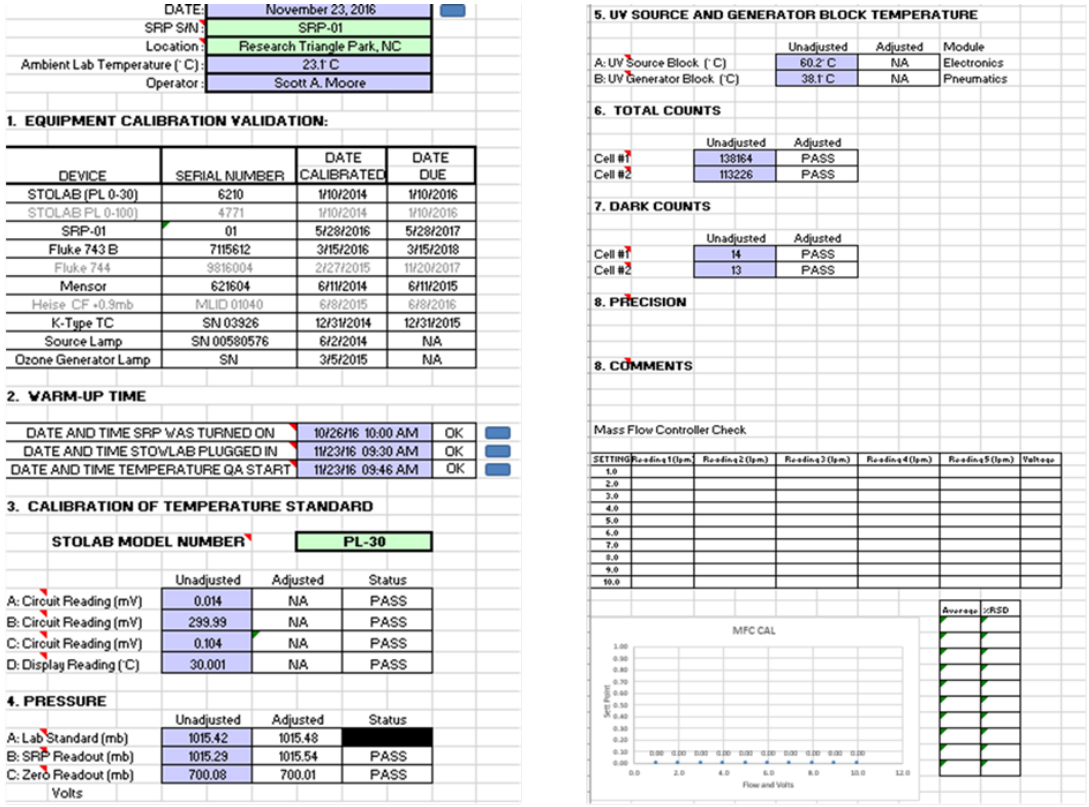
The Regional SRP Operator will be responsible for establishing and implementing internal QC procedures for the measurement of the SRP to SRP verifications and the SRP to Level 2 verifications, along with associated documentation such as:

- SOPs, laboratory notebooks and maintenance records
- Analytical and support equipment selected to conduct the verification
- Configuration of analytical instruments
- Documentation of the measurements and QC checks via the Operation Characteristic Data Sheet (OCDS) (see Figure 14.1)
- Estimated uncertainty of the measured concentrations via the SRP software

Table 7-1 in Section 7 provides the QC checks that will be implemented for this program. Section 4 of the SRP SOP provides procedures for all the QC checks described in Table 7-1.

There are only two files/programs needed to implement and document a verification:

The SRP OCDS- Figure 14.1 the OCDS provides the preliminary information necessary to check the SRPs operation before a verification begins. Procedures for implementing these checks can be found in Section 4 of the SRP-SOP. These checks must pass for the host instrument prior to the start of a verification.



DATE:	November 23, 2016
SRP S/N:	SRP-01
Location:	Research Triangle Park, NC
Ambient Lab Temperature (°C):	23.1°C
Operator:	Scott A. Moore

1. EQUIPMENT CALIBRATION VALIDATION:

DEVICE	SERIAL NUMBER	DATE CALIBRATED	DATE DUE
STOLAB (PL 0-30)	6210	1/10/2014	1/10/2016
STOLAB PL 0-100)	4771	1/10/2014	1/10/2016
SRP-01	01	5/28/2016	5/28/2017
Fluke 743 B	7115612	3/15/2016	3/15/2018
Fluke 744	9816004	2/27/2015	11/20/2017
Mensor	621604	6/11/2014	6/11/2015
Heise CF +0.9mb	MLID 01040	6/8/2015	6/8/2016
K-Type TC	SN 03926	12/31/2014	12/31/2015
Source Lamp	SN 00580576	6/2/2014	NA
Ozone Generator Lamp	SN	3/5/2015	NA

2. WARM-UP TIME

DATE AND TIME SRP WAS TURNED ON	10/26/16 10:00 AM	OK
DATE AND TIME STOWLAB PLUGGED IN	11/23/16 09:30 AM	OK
DATE AND TIME TEMPERATURE QA START	11/23/16 09:46 AM	OK

3. CALIBRATION OF TEMPERATURE STANDARD

STOLAB MODEL NUMBER PL-30

	Unadjusted	Adjusted	Status
A: Circuit Reading (mV)	0.014	NA	PASS
B: Circuit Reading (mV)	299.99	NA	PASS
C: Circuit Reading (mV)	0.104	NA	PASS
D: Display Reading (°C)	30.001	NA	PASS

4. PRESSURE

	Unadjusted	Adjusted	Status
A: Lab Standard (mb)	1015.42	1015.48	
B: SRP Readout (mb)	1015.29	1015.54	PASS
C: Zero Readout (mb)	700.08	700.01	PASS
Volts			

5. UV SOURCE AND GENERATOR BLOCK TEMPERATURE

	Unadjusted	Adjusted	Module
A: UV Source Block (°C)	60.2°C	NA	Electronics
B: UV Generator Block (°C)	38.1°C	NA	Pneumatics

6. TOTAL COUNTS

	Unadjusted	Adjusted
Cell #1	138164	PASS
Cell #2	113226	PASS

7. DARK COUNTS

	Unadjusted	Adjusted
Cell #1	14	PASS
Cell #2	13	PASS

8. PRECISION

8. COMMENTS

Mass Flow Controller Check

SETTING	Reading1 (lpm)	Reading2 (lpm)	Reading3 (lpm)	Reading4 (lpm)	Reading5 (lpm)	Voltage
1.0						
2.0						
3.0						
4.0						
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						

Average	%RSD

Figure 14.1Operation Characteristic Data Sheet

The Verification Data- The SRP program uses SRP Control Software developed by NIST for the verification application which can input both the host and guest instruments to set up a verification run, program the necessary concentration levels, and collect the information to assess the verification. Procedures for the Control Software can be found in the SOP in Sections 9.3.6, 9.3.7, and 9.7

14.2 Reporting

An example of the results from a verification run are illustrated in Figure 14.2.

Standard Reference Photometer

Verification Report

Calibrating Institute:	EPA Region 9			**Date:**	13-Mar-14
Operator:	Bob Hopeman			**Start Time:**	20:05
Instrument:	SRP 36	Cell Length=89.59		**End Time:**	22:10
Comment:	SRP 36 vs. SRP 7			**Filename:**	c0313002.xls

Calibrated Instrument:	SRP 7	Cell Length=89.40	**Calibration**		**Standard**
Owner:	OAQPS		**Results**	**Value**	**Uncertainty**
Contact:	Scott Moore		**Slope**	1.00169	0.00012
Make:	SRP		**Intercept**	0.15209	0.05035
Model:	SRP		**Covariance**		-5.2459E-09
Serial Number:	7		**Res Std Dev**	0.10872	

Calibration Parameters:	Zero Start&End;Raw Saved;Dark Count On (4)			
Air Flow Rate:	6.0	l/min		
Lamp Intensity Range:	0.0	to	88.0	%
Number Conc. Points:	12		**Points/Concentration:**	12
Conditioning:	none			

Calibration	**SRP 36**		**SRP 7**		**SRP 7**	
Data Points	**Result**	**Std. Dev**	**Result**	**Std. Dev**	**Predicted**	**Residual**
Dark Count 1	7		16			
Dark Count 2	13		17			
1	0.0	0.2	0.2	0.1	0.15	0.02
2	785.9	0.2	787.4	0.6	787.38	-0.02
3	680.3	0.2	681.5	0.5	681.58	-0.11
4	584.1	1.0	585.5	0.5	585.24	0.28
5	492.7	0.4	493.7	0.4	493.70	-0.03
6	407.8	0.5	408.5	0.3	408.66	-0.15
7	324.4	0.4	325.1	0.3	325.09	0.02
8	241.8	0.2	242.4	0.2	242.41	-0.03
9	144.9	0.2	145.4	0.2	145.32	0.06
10	45.6	0.2	45.9	0.1	45.88	0.01
11	16.0	0.2	16.1	0.1	16.17	-0.09
12	-0.1	0.1	0.1	0.2	0.05	0.04

Ordinary Least Squares	
1.00169431	0.152088621
0.00012279	0.050351308
0.99999985	0.114028881
66546861.1	10
865281.268	0.130025858
U(m,b)	-5.24592E-09
Res StdDev	0.108722272
Points	12
Data Ranges	
SRP	$C$24:$C$35
Guest	$E$24:$E$35
Predicted	$G$24:$G$35
Residual	$H$24:$H$35
LampSettings	
0	
88	
79.67	
71.33	
63	
54.67	
46.33	
38	
29.67	
21.33	
13	
0	

Figure 14.2 Example Verification Report

Upon completion of a full verification, a report is generated. Figure 14.3 represents an example summary report for the verification of SRP-36. The highlight row represents the data for the verification shown in Figure 14.2. The RTP verifier will send a pdf of the NIST Report of Calibration of the host instrument (usually #7) with the instrument. The Standard Uncertainties are available for review. Data for SRP to SRP verification are filed at RTP and the respective EPA Regions while SRP to Level 2 verifications are filed at the office for which they are performed. These data files and reports will be stored as described in Section 9

U. S. Environmental Protection Agency
Office of Research and Development
Air Pollution Prevention and Control Division
Technical Services Branch
109 T.W. Alexander Drive
RTP, NC 27711

	Primary Standard			**Guest Information**	
U.S. EPA	**Agency:**	**EPA RTP**	**Agency:**	EPA Region 9
Scott Moore	**Contact:**	**Scott Moore**	**Contact:**	Kevin Woodruff
4930 Old Page Rd.	**Make:**	**NIST**	**Make:**	NIST
RTP, NC 27709	**Model:**	**SRP**	**Model:**	Std. Ref. Photometer
(919) 541-5104	**S/N:**	**7**	**S/N:**	36
moore.scott@epa.gov	**NIST Ver.**	**Apr 18, 2013**	**Offset:**	0
	Level	**1**	**Status:**	**PASS**

	Slope	Intercept	R^2
Averages:	0.9990	0.0630	0.99999968
Upper Limit:	1.0100	1.0000	NA
Lower Limit	0.9900	-1.0000	NA

Date Start	Time Start	Date End	Time End	File	Slope	Intercept	R^2
03/11/14	11:19	03/11/14	13:45	c0311001.xls	0.9972	0.0299	0.99999985
03/11/14	13:45	03/11/14	15:49	c0311002.xls	0.9968	0.0769	0.99999975
03/11/14	15:49	03/11/14	17:58	c0311003.xls	0.9962	-0.0233	0.99999976
03/12/14	13:28	03/12/14	15:40	c0312001.xls	0.9961	-0.0678	0.99999969
03/12/14	15:40	03/12/14	17:51	c0312002.xls	0.9990	0.0901	0.99999875
03/12/14	17:51	03/12/14	19:58	c0312003.xls	1.0008	0.0268	0.99999985
03/13/14	17:55	03/13/14	20:05	c0313001.xls	1.0017	0.1480	0.99999995
03/13/14	20:05	03/13/14	22:10	c0313002.xls	1.0017	0.1521	0.99999985
03/13/14	22:10	03/14/14	0:16	c0313003.xls	1.0018	0.1339	0.99999970

Comments: Average concentrations ran were 806, 699, 600, 507, 419, 333, 247, 149, 47 and 16 ppb Ozone with a Zero at the start and at the end. Next re-verification will be due on or before 03/13/15. The minimum parameters for a re-verification is 10 concentration points with a Zero at the beginning and at the end and three consecutive cycles that can be run all on the same day. Observations: The Cell length for SRP-07 is recorded as 89.40cm and this is incorrect and needs to be updated as soon as possible. The correct cell length for SRP-07 is 89.727cm. The Scalers counts for SRP-36 are very low. As specified in your QA sheet the range for the scalers should be between 90,000 and 100,000. To correct this, the power can be turned up using the blue pot on the Ozone board. If that is maxed out then you may need a new lamp. A newer version of the QA Sheet has a range from 250,000 to 100,000. There is a note on the bottom of the Temperature data check that states " NOTE: If any one of these settings needed to be corrected then all readings need to be re-measured." There is one step missing from both 07 and 36 Temperature QA data. Also the Zero reading for the Barometric Pressure is missing on the SRP-36 data sheet. Please contact me for any assistance with your instrument.

Scott A. Moore Scott A. Moore DATE: October 20, 2014

Figure 14.3 Example Verification Summary Report

15.0 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The purpose of this element is to discuss the procedures used to verify that all instruments and equipment are maintained in sound operating condition, especially after shipping, and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities are documented and filed.

15.1 Testing

15.1.1 Equipment Testing

The following equipment is used in the EPA's SRP Program

- NIST Standard Reference Photometers (SRPs)
- Thermo 49C or i and /or API Teledyne 400 Ozone standards (Optional but nice to have a transfer standard available)
- API Teledyne 701H or other Zero Air Generator
- Environics calibrator or other Ozone Generator-containing device (this is optional)
- Primary flow standard (BIOS ML-800 and BIOS Definer 220), MolBlok or Gilabrator.
- SRP temperature and pressure sensors
- Lab temperature, pressure, and RH Standards

SRPs and support instruments used for the EPA SRP Program have been used for verifications by trained EPA RTP and EPA Regional SRP operator staff for many years and are known to be suitable for this activity. Testing of this equipment occurs through the use of annual SRP verifications. The SRPs and support equipment are used to certify (verify, but not adjust/calibrate) the commercial ozone standard equipment (Level 2 and greater transfer standards), perform ongoing SRP QC checks, and are used as source of the known concentrations from which the verification/re-verifications are performed.

Failure of the SRP, based upon QC checks, will result in troubleshooting and re-calibrations. If Regional SRP trouble shooting and recalibration is not successful, OAQPS and ORD APPCD in RTP will be notified. APPCD has thoroughly checked and had NIST recertify at least one of the 2 (traveling and non-traveling) RTP SRPs each year. This traveling SRP will replace the Regional SRP until the Regional SRP can be repaired and calibrated.

15.1.2 SRP Testing

Since the agreement of the Photometers from the Regional SRPs are key to a successful SRP program, their performance will be monitored and will be re-verified by EPA RTP SRPs before the estimated expiration date of the last Regional SRP verification if required. This RTP SRP re-verification, with an acceptable result, will provide assurance of the quality of the verification data.

15.2 Inspection

Inspection of various equipment and components can be subdivided into the laboratory and field activities.

15.2.1 Inspection in the Regions

SRP-07 will be accompanied by a certificate verification from RTP and the certificate of Analysis from NIST (per Section 3.9 of the SRP SOP). Regional SRP Operators will perform an inspection upon receipt of the traveling SRP (per Section 9.2 of the SRP SOP) to ensure that the traveling SRP integrity appears intact and that the certificate of verification (RTP) and Analysis (NIST) is complete.

15.2.2 Annual Inspection of Laboratory Items

In addition to the 3 SRP modules (Pneumatic, Electronic, and Bench), there are several items that need routine inspection in the laboratory. The following items will be inspected on an annual basis:

- Leaks in stainless steel and Teflon tubing and fittings used in the SRP interconnection arrangements for multi-device comparisons.
- Leaks in the SRP module connections used in the verification comparisons
- Minimum of 15 psi zero air gas supply sufficient for the ozone and zero air used in the comparisons
- Leaks/cracks in ¼” o.d. thin walled Teflon tubing
- NIST’s SRP computer data acquisition system
- Leaks around ¼” Swagelok nuts and ferrules

15.3 Maintenance

There are items in the laboratory that need maintenance attention in the SRP program. There are no maintenance activities associated with the field.

15.3.1 Laboratory Maintenance Items

The successful execution of a preventive maintenance program by the SRP Regional operators will go a long way towards the success of the SRP Program. Table 15-1 provides information on laboratory preventive maintenance. The laboratory notebook will document maintenance activities.

Table 15-1 Preventive Maintenance in SRP- Laboratories

Item	Responsibility	Frequency
General laboratory maintenance/cleaning		
Table cleaning	Laboratory Analyst (LA)	Every day of a verification/re-verification
Overall laboratory	LA	Once a month
Analytical Equipment		
Cleaning	LA	Every 6 months
Calibration/verification	LA	Annually
Tubing replacement	LA	Annually
Regulator cleaning	LA/Support staff	Yearly
Laboratory Computers		
Computer backup	LA	Flash drive backup with every verification run
SRP database distribution to OAQPS?	LA	Flash drive backup with every
Computer system preventive maintenance (clean out old files, compress hard drive, inspect)	PC support personnel	As needed

16.0 Instrument Calibration and Frequency

The purpose of this element is to discuss the procedures used to verify that the SRP components, and all instruments and equipment used to do the QC checks on the SRPs, are calibrated and are capable of operating at acceptable performance levels. All instrument calibration activities are documented and filed.

16.1 Calibration

16.1.1 Equipment Testing and Frequency

The following equipment is used to perform the QC checks on critical components of the SRPs in the EPA's SRP Program, and need to be calibrated (certified) against a more accurate (higher level) standard, at an acceptable frequency, in both RTP and the Regions. These activities need to be recorded, signed and dated, and the records and certificates kept available for auditing.

- Primary flow standard (BIOS ML-800 and BIOS Definer 220); not critical for ozone concentration, but valuable to have available for troubleshooting.
- SRP Lab pressure sensor (Barometric Pressure Standard, to measure in millibars (mb), with a resolution of at least 0.1 mb; recertified annually
- SRP Lab temperature standard (e.g., a STOLAB Temperature Calibrator), recertified annually
- Voltmeter, accurate to (resolution of) at least 0.1 mv (e.g., Fluke 744B "Calibrator"); recertified within up to 2 years

17.0 Inspection/Acceptance for Supplies, Consumables and Spare Parts

The purpose of this element is to discuss the procedures used to verify that all supplies, consumables and spare parts needed to ensure the continuing adequate performance of the RTP and Regional EPA SRPs are on hand, meet the required specifications and are maintained in sound operating condition, especially after shipping, and are capable of operating at acceptable performance levels. All supplies, consumables and spare parts inspection and acceptance activities are documented and filed.

17.1 Supplies, Consumables, and Spare Parts

The following supplies, consumables, and spare parts should be kept on hand in RTP, at least, and, potentially in each Region, for use in the EPA's SRP Program

- Scrubber materials for the zero air supply (purafil, Mole sieve, activated charcoal, etc.)
- Brailsford (and any other) pumps (and/or pump parts)
- O-rings, diaphragms
- Ultra Violet (UV) lamps for the detector and for the ozone generator
- Dwyer Rotameter (s)
- STOLAB Low Temperature Calibrator
- Spare circuit boards and power supplies (RTP)
- Teflon tubing and fittings

17.2 Inspection and Acceptance

> **NOTE**: If, upon inspection, a problem is discovered, email the exact details immediately to the manufacturer or distributor from whom you purchased these items. You should not accept damaged goods, and the email should document what you have found. A good manufacturer and/or distributor should stand by what they send you.

Upon inspection, the scrubber materials should not appear to be clumped together, nor should there be any sign of moisture or unexpected coloration. They should already be in, or, if not, put in containers that will keep moisture or other contaminants away from them while they are in storage.

The Brailsford pumps should be inspected for any sign of shipping damage. This procedure can be facilitated if accompanying paperwork includes a diagram of the pump. If appropriate power (24 VDC) can be applied, as a test that the pump is working. If not available, upon receipt from

shipping, and if no verification needs to occur immediately, then the new pump could be used in place of the one already in the SRP.

The O-rings and diaphragms should be received in protective shipping containers, such as sealed, transparent plastic bags. They should not be moist, oily, or discolored. They should not have any cuts or creases. They should be flexible, not rigid.

The UV Lamps should be carefully inspected to make sure there is no damage; no breaks in the glass, no breaks in any visible wires, or breaks or bends in metal plug in connectors.

Inspect the Dwyer Rotameters and insure that there are no cracks, that the rotameter level indicating ball is present and moves freely, that the rotameter flow rate indicating lines are present and easily readable; and that there is no inappropriate material, either wet or dried, on the inside of the rotameter cylinder.

Inspect the STOLAB Temperature Cards and the Ozone Generator block to make sure they are seated well in place (most often they come loose during shipping) and have not incurred any shipping damage. Look for dents, component breaks, in comparison to diagrams from the manufacturers, and to the existing identical parts in the SRPs.

The (FEP) Teflon tubing and fittings should be received in protective shipping containers, such as sealed, transparent plastic bags. They should not be moist, oily, or discolored. The tubing should not have any (sharp) bends, and no cuts or breaks. The tubing should be flexible, not rigid. Make sure that the fittings have any necessary ferules; and that the threads inside the ferule caps, and that their other, mating halves, are present, and are not stripped or dented in any way.

18.0 Data Acquisition Requirements

This element addresses data not obtained by direct measurement from the SRP Program. Since all of the data used in the SRP Program will be direct measurements acquired by the SRP Program laboratory analysts, this section is not applicable.

19.0 Data Management

This element will discuss the SRP Program's important information that needs to be collected, stored, and reported, and how those functions will be managed. Currently, all QC check, verification and reporting documentation is kept by the SRP operators performing the activities in the locations where the activities are performed. NIST keeps their records, EPA RTP keeps their records, and the Regions keep their records. The one exception, so far, is that a Report of Calibration that documents the NIST SRP to RTP SRP comparison. This comparison is provided to RTP and RTP provides a copy of the document to the Regions along with the traveling SRP.

The majority of data used in the EPA SRP program will be direct measurements acquired by the RTP and Regional EPA SRP operators in the SRP software systems.

19.1 Information Needed for the SRP Program

Information required to successfully implement the EPA SRP program include:

- Paper or electronic records of SRP related purchases, and of maintenance and calibrations of the Temperature, Pressure, and voltage testing/calibrating equipment, and the zero air providing equipment, used to support the accurate and reliable performance of the SRP.
- Electronic records of the QC checks (Fig. 14.1) and verifications performed by the EPA RTP or Regional SRP laboratory operators.

19.2 Computer Hardware and Software

Hardware:

Over the past several years, the network of NIST SRPs has undergone significant upgrades in its electronic systems, sampling configuration, and control software. Each SRP consists of a separate optical bench and two instrumentation modules (electronics and pneumatics). The Optical Bench consists of a single mercury ultraviolet (UV) discharge lamp, UV filter, UV beam splitter, two absorption cells, and signal-processing electronics

SRPs made by NIST and used by EPA have been upgraded over time. From 1989 through 2004, a series of 11 individual upgrades were made, including redesign" of the detector module (see reference, "Upgrade and Intercomparison…," June, 2004). The following material in quotes are derived from the two references listed in section 12.4.

The first upgrade involved “replacing 4 independent function circuit boards, and a separate relay circuit board, with one main circuit board, called the Digital Interface and Timing Generation (DI/TG) Board. Board connections and mounting bracket were improved, and a 24 DC volt power supply added. Critical parameter adjustment controls were installed on the front panel, which allowed the unit to remain thermally stable during adjustment, which the old design had not allowed. The main board is a multi-layer board providing more stringent handling of transmitted signals. Particular attention was paid to separation of the digital and analog grounds to avoid interference, and various test points are available for convenience during testing. The specifications of the signal amplifiers used on the temperature and pressure input signals are 50% more stable than those used in the original design. Electric contact relays used in the original design for powering the lamp shutter and solenoid valves were replaced by solid state relays, thus minimizing power spikes throughout the system. The front panel displays for the two scaler channels, temperature and pressure, are brighter and easier to view”.

“The electronics upgrade also involved a complete redesign of the detector module. The original housing was costly and impractical. The new design utilizes an extruded aluminum box with internal mounting brackets. The new detector/ preamp board provides 2 independent, stable voltages corresponding to the light intensity in the absorption cells and utilizes a signal amplifier with a factor of 5 improvement in stability compared to its predecessor. The new detector V/f converters are more stable, and three times faster than the previous ones. These features provide increased measurement sensitivity through higher resolution scalar counts, and longer source lamp life. The open-collector devices used in the original design for transmitting the V/f output signals to the electronics module were replaced with TTL line drivers. Further design improvements were made such that these signals are now transmitted over independent coaxial cables for improved signal fidelity. Summary: Overall, the new detector modules provide faster V/f conversion, a lower noise level, and a smoother output signal.”

“Use of the Industry Standard Architecture (ISA) bus in Personal Computers (PCs) has vanished, and it has become impossible to purchase a PC with the ISA expansion slots necessary for the operation of the version 3 software. A fourth generation control program for the SRP has been developed by NIST. New software was required due to the unavailability of new computers with the ISA bus. New computers then became available with the Peripheral Component Interface (PCI) bus only, which means that the SRPs had to use these PCI control cards. A direct replacement of the ISA multi-function card previously used was not available in a PCI version. The PCI replacement uses a different connector, so an additional signal distribution module was designed and produced to handle the new connector used on the PCI card. This modification allowed continued use of existing SRP control cables. A direct replacement for the 24-bit Digital Input/ Output (DIO) card for controlling a guest SRP became available for PCI bus operation.

Several of the EPA operators had their SRP computer connected to the Agency network as a convenient way to store data to a server and work on data from a remote location. Newer computers may have at least one PCI slot and several e-PCIs."

A "dual external manifold was designed using borosilicate glass and the same fittings as on the original SRP nmanifolds.TO incorporate the new manifolds into existing SRPs, the original manifolds were removed from the front panel of the pneumatics module, and an adaptor plate installed with 2 Teflon bulkhead unions. The new arrangement has allowed easy connections to manifolds in commercial ozone instruments."

By April of 2013, the redesign and testing of the source /optics lamp block with different mounting components had been made and tested. During the same period, an issue of optical path length bias had been addressed, and then tested, using a modified design for the optical cell, incorporating 3°-tilted windows. The SRPs upgraded with these changes have shown improved overall agreement.

Software

The first SRP version control software was written in HP Series 80 software. Version 2 was written in QuickBasic version 4.5. Version 3 was written using "C" programming language, using a front end graphical interface similar to Windows, but was Disk Operating system (DOS)–based. In 2000, new hardware using Peripheral Component Interconnect (PCI) control cards and Windows Based Visual Basic software were used. In Nov.2001/April 2002, new version software was written in Visual Basic Version 6, under a Windows NT, 2000, or XP environment, and works with EXCEL 2003. It is planned that software written in Lab View will replace Visual Basic.

Physical and Chemical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information, which has not already been specified in the monitoring regulations, will be obtained from nationally (and internationally) recognized sources. Other data sources may be used with approval from the National SRP Program Project Leader. The following sources may be used in the EPA SRP Program without prior approval.

NIST –US SRP Technical Lead, makes all SRPs; tests, and retests EPA RTP SRPs

- International Organization for Standardization (ISO), International Union of Pure and Applied Chemistry (IUPAC), American National Standards Institute (ANSI), and other widely recognized national and international standards organizations.

- The US Environmental Protection Agency (EPA). Particularly relevant is the Technical Assistance Document (TAD), Transfer Standards for the Calibration of Air Monitoring Analyzers for Ozone (5/31/2009).

- The current edition of certain standard handbooks may be used without prior approval from the EPA OAQPS SRP Program Project Leader. Two that are relevant are the CRC Press Handbook of Chemistry and Physics and Lange's Handbook of Chemistry.

Proposed Future Upgrades: Low voltage temperature cards, made by the company STOLAB**,** to minimize a 0.2 °C observed temperature bias; four temperature sensors, one each on the inlet and outlet of each of the cells. Possibly two pressure transducers to measure the pressure from each cell and the LabView Control Software.

19.3 Data Recording

It is the policy of the EPA SRP Program that no data obtained from the Internet, computer bulletin boards, or databases from outside organizations shall be used in creating reportable data or published reports without approval from the National EPA SRP Program Leader. Requests may be raised to the SRP Program Leader, who will discuss it with the OAQPS and ORD management of the Program. This policy is intended to ensure the use of high quality data in EPA SRP publications.

20.0 Assessments and Response Actions

For the purposes of this QAPP, an assessment is defined as an evaluation process used to measure the performance of the quality system and various measurement phases of the data operation.

The results of assessments indicate whether the QA/QC efforts are adequate or need to be improved. Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality.

To ensure the adequate performance of the quality system, the SRP Program will perform the following assessments:

- Data Quality Assessments (DQAs)
- Performance Evaluations – The inter-comparisons between NIST and RTP, between RTP and the Regions, and then between the Regions and the states, are Performance Evaluations of the highest order.

20.1 Assessment Activities and Project Planning

20.1.1 Data Quality Assessments

A DQA is a statistical analysis of environmental data used to determine whether the quality of data is adequate to support a decision based on the DQOs. Data are appropriate if the level of uncertainty is acceptable for the decision (intended use of the data) based on the data.

For NIST to RTP Verifications and RTP to Regional SRP verifications, the SRP acceptance criteria must be met or the Level 1 SRP will be taken off line and repaired and only put back into service when the SRP meets acceptance criteria. However, every three years EPA will provide a DQA of the Level 1 SRP data and the Level 1 to Level 2 data in the network to evaluated how well the acceptance criteria is being met. This information may identify trends in data quality that may be used to take corrective actions.

20.1.2 Performance Evaluations

Performance evaluations (PEs) are a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst, or a laboratory. NIST will be invited to audit the verification activities by challenging the measurement system with an independent SRP. This is done every year for the RTP SRPs by bringing them to NIST and having NIST verify one or both of the RTP SRPs against one or both of the NIST Gaithersburg, MD-based SRPs.

20.2 Documentation of Assessments

Table 20-1 summarizes each of the assessments discussed above.

Table 20-1. Assessment Summary

Assessment Activity	Frequency	Personnel Responsible	Report Completion	Resolution
DQAs	1/3 year	Reg, ORD, OAQPS	120 days after the calendar year	OAQPS, ORD-APPCD
PE	Every year	ORD, NIST,	30 days after the activity	APPCD, OAQPS

21.0 Reports to Management

This element describes the quality–related reports and communications to management necessary to support the SRP program. For the SRP program, management is considered to be the supervisor of the ORD technical lead, the OAQPS AAMG QA team leader, and the OAQPS AAMG Group leader, who is the supervisor of the AAMG QA Team leader and of the AAMG SRP Program lead; and the EPA Regional Managers of the EPA Regional SRP operators; and the supervisor of the California Air Resources Board's SRP operator.

21.1 Verification Reports

Within two to three weeks of completion of a verification, the RTP or Regional SRP operator will report its verification results in the form of a database file to the RTP ORD APPCD SRP technical lead and OAQPS and to the appropriate agency monitoring organization. At a minimum, the draft verification results shall include:

- The name of the agency and a description of the agency's primary standard, and original certified characterization of its ozone response slope, intercept, and uncertainties.
- the raw measurement data, measured concentrations, and estimated total uncertainties.
- the percent (or, for low concentrations, ppb) difference between original certified concentrations and calculated measured concentrations.
- a documentation checklist for each EPA certified concentration with any non-conformances (concentration outside of the SRP SOP's acceptance limits.
- written documentation showing the calculation that the SRP, or agency primary standard operator, used to convert the raw measurement data into the measured concentrations, and their estimated uncertainties.

21.2 Annual Verification Report Summary

Each year ORD/OAQPS will provide a summary report on AMTIC that include the dates when the NIST to RTP and the RTP to Regional Level 1 SRPOs were scheduled, when they were accomplished and whether the results were acceptable. Comment will be included if there are any technical issues with the verification. This Summary will be posted on the SRP page of AMTIC.

EPA Regions will keep a similar summary of SRP to Level 2 verification. Fields for this report will be similar to the summary described above but will include PQAO and monitoring agency codes.

21.3 SRP 3-Year QA Report

The report will provide a summary of the QA information related to the SRP program. It will summarize the QC data from all the runs with respect to achieving the MQOs as well as aggregating QC data from the runs to provide overall data quality statistics for each Region and RTP. It will summarize any external assessments that were performed, the audit results and findings, and any corrective actions that were needed. It will provide lessons learned and improvements needed for program improvement.

22.0 Data Review, Validation, and Verification Requirements

This element describes how the SRP program will verify and validate the data collection operations associated with the program. "Verification" can be defined as confirmation by examination and provision of objective evidence that *specified requirements* have been fulfilled. "Validation" can be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specific *intended use* are fulfilled. The major objective for the SRP program is to Ensure standards used to calibrate and QC ozone monitors meet acceptance requirements and are traceable to NIST.

This section will describe the verification and validation activities that occur during a number of the important data collection phases. Earlier elements of this QAPP and the SRP SOPs describe how the activities in these data collection phases will be implemented to meet the DQOs of the program. Review and approval of this QAPP provide initial agreement that the processes described in the QAPP, if implemented, will provide data of adequate quality. To verify and validate the phases of the data collection operation, the SRP program will use various qualitative assessments (e.g., performance evaluations, technical system audits, etc.) to verify that the QAPP is being followed and will rely on the various laboratory QC checks to validate the measurement process.

22.1 Verification/Validation Through the SRP Digital Data System

As indicated in Section 13.0, *Analytical Methods Requirements*, details of the requirements for the analytical methods are given in the SRP SOP. The verification/validation process for the SRP program is fairly simple. If the Regional SRP operators' verifications of their SRP to the RTP or NIST SRP are within the acceptable range, then one can expect that the derived concentrations of the SRPs against the state, local, tribal, or CASTNET level 2 ozone standards are acceptable.

As explained in section 19, *Data Management*, the RTP or Regional SRP operators will use SRP software system to generate the verification reports needed for the program. Verification reports can be seen in Element 14.

23.0 Reconciliation with Data Quality Objectives

Due to the nature and use of the data, all MQOs in Table 7-1 will be achieved before the Regional SRP concentration data will be considered acceptable. If these criteria are not met the Regional SRP will be taken off line and will either be replaced by an RTP SRP, or verification will be delayed or moved to another Region until the SRP meets the acceptance criteria.

Table 7-1 also lists the acceptance requirements for the Regional SRP verifications against the Level 2 standards. Based on the information provided above, if the acceptance criteria is not met, the Level 2 standard is considered suspect. EPA Regions are not responsible for determining the cause nor taking corrective action to fix the Level 2 standard. Further corrective action is the responsibility of the monitoring organization. If the Region notices a trend in failure rates of the Level 2 standards it may believe that the SRP has degraded and should contact ORD for a re-verification of the SRP.