WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Ozone Monitoring Procedure

Air Quality Program

April 2008

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State of Washington
Department of Ecology
Air Quality Program

OZONE MONITORING PROCEDURE

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April 2008

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1 INTRODUCTION

This document is intended for individuals responsible for collecting ozone data supported by the Washington State Department of Ecology (Ecology).

The U.S. Environmental Protection Agency (EPA) has determined ground level ozone is a health and environmental concern. National Ambient Air Quality Standards (NAAQS) for ozone are for the protection of public health. EPA requires that states monitor for ozone to demonstrate that ozone standards are being met. Ecology's Air Quality Program has the responsibility to monitor for ozone and has an established network of ozone monitoring stations operated by personnel from various agencies.

This document was written to assist personnel tasked with operating ozone instruments in Ecology's air monitoring network. The successful capture of accurate data with minimal loss will depend not only on reliable equipment, but with procedures designed to assure that Ecology's Data Quality Objectives are met.

Data Quality Objectives

Data Quality Objectives (DQOs) are a set of specifications needed to design a data collection effort that maximize the likelihood data will be adequate for its intended use.

Specific monitoring objectives must be determined to design a strategy that will effectively meet the objectives and the resources. Ecology's Air Quality Program DQOs are designed to determine:

- The highest concentrations of ozone expected to occur in the area.
- Representative concentrations of ozone in areas of high population density.
- General background ozone concentration levels.
- Collect only credible data that has the greatest opportunities to benefit public health.
- Focus sampling where the information is critical to protect or assess public health.

Careful Site Selection for Ozone Monitoring

Ozone is not emitted directly into the air, but is a result of a complex photochemical reaction involving organic compounds, oxides of nitrogen, and solar radiation. Ozone can cover a widespread area when conditions conducive to its formation occur.

The highest ozone episodes in Washington State occur when a slow-moving, high-pressure system develops in the summer promoted by the combination of hydrocarbons, high solar radiation and high air temperatures. This complex relationship involving precursors of ozone (i.e. transportation and industrial sources), local meteorology, population and topography determines where monitoring takes place in order to meet the DQOs.

Ecology ozone analyzers are housed in shelters usually located downwind of large metropolitan areas (Seattle/Tacoma/Bellevue, Portland/Vancouver, and Spokane) and operate from May through September when ozone concentrations rise.

Theory of Operation

All ozone analyzers operating in Ecology's air monitoring network use the basic principle of Beer's Law to measure for ozone in the atmosphere. The Beer-Lambert equation defines how light of a specific wavelength is absorbed by a particular gas molecule over a certain distance at a given temperature and pressure.

The ozone analyzer is simply an optics bench (absorptions tubes) controlled by a microprocessor. A sample of ambient air is drawn into the instrument and is illuminated at one end of the optics bench by a UV lamp. The intensity of the lamp is measured at the opposite end by a detector. Each sample measurement contains two half cycles, one with zero gas and the other with the sample gas. After each cycle, the intensity of the light is stored by the microprocessor. The difference between the two half cycles is the amount of ozone in the ambient sample.

The microprocessor records the UV absorption measurements made after each cycle, the current temperature and pressure, then applies a stored calibration curve on the sample to calculate a final ozone concentration. This concentration value is reported to the user via a front panel display or a variety of digital and analog signal outputs. This cycle is repeated every six seconds.

Locating the Monitoring Station

The monitoring equipment is housed in a clean, dry, secure and temperature controlled space.

Careful thought and planning is required in locating a monitoring station. The individual responsible for the installation must consider:

- Proximity to the nearest power source. A 120 VAC source is required for operation of the ozone monitoring instruments.
- The space where the equipment is housed requires the need for an air conditioner and a heater controlled by a thermostat.
- The availability of monitoring equipment.
- The accessibility of the equipment to the operator. The operator must be able to safely access the equipment during regular business hours.
- The security of the equipment. Monitoring instruments are expensive. They must be placed in a location where security can be assured.
- Contracts for rental of space or power. Contracts need to be signed with the owner of the property where the instruments are to be located.
- Must have DSL access or USB modem access.

- Local building codes. In most cases, the contractor installing the power, structure, concrete, etc. know the local building codes. The individual responsible for the installation should call the building facility management staff to inquire about the proposed plan and what is required.

- Noise considerations. The noise of the pumps in the instruments can be annoying if people are located nearby. It may be necessary to demonstrate how loud the instrument is before commitments are made.

- Aesthetics of the monitoring station and sample probe. An air monitoring shelter or a sampling probe attached to a building may detract from the aesthetics of the structure. It is a good idea to have photos or a diagram to explain the proposal.

Most ozone monitoring stations are small temperature controlled shelters designed specifically for air monitoring purposes. The shelters are placed on a concrete pad surrounded by a fence to provide security.

Probe Placement

Once the location of the station has been identified, the individual responsible for the installation must be familiar with the criteria for locating the probe. The location of the sample probe is critical and individuals performing the installation must follow specific guidelines involving;

- The distance of the probe inlet from nearby obstructions (buildings and trees).

- The vertical and horizontal distance of the probe inlet from the ground and support structure.

- Air flow around the inlet of the probe.

- The distance of the probe inlet from nearby roads.

These guidelines often dictate the location of the air monitoring station. Requirements for locating the probe are summarized in Table 1. For new installations in the Ecology air monitoring network, a Probe Inlet Site Criteria Checklist must be completed once the probe has been installed and the station is operational.

For specific information on monitoring site criteria refer to *Title 40, Code of Federal Regulations, Part 58*[1] *(40 CFR 58)* and Washington State Department of Ecology, Air Quality Program, *Site Selection and Installation Procedures*[2].

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[1] To obtain a copy of *40 CFR Part 58* contact Superintendent of Documents, Government Printing Office, Washington, DC 20402 (phone 202-783-3238).

[2] To obtain a copy of *Site Selection and Installation Procedures* contact the Washington State Department of Ecology, Air Program/Quality Assurance Unit, P. O. Box 47600, P.O. Box 47600, Olympia, WA 98504-7600 (phone 360-407-6837).

Table 1 Requirement for Locating the Probe

Scale	Height Above Ground in Meters	Distance From Supporting Structures in Meters		Other Spatial Criteria
		Vertical	Horizontal	
Micro	3 ± ½	≥ 1	≥ 1	Must be at least 10 meters from nearest intersection and should be at a mid-block location. Must be at least 2 meters and no more than 10 meters from edge of nearest traffic lane. 3. Must have an unrestricted air flow of 270º around the inlet probe, or 180º if located on side of building
Middle and Neighbor-hood	Between 3 and 15	≥ 1	≥ 1	Must have an unrestricted airflow of 270º around the inlet probe, or 180º if located on side of building. 2. Spacing from roads varies with traffic (see 40 CFR Part 58, Appendix E).

2 STATION INSTALLATION

An air monitoring station contains several instruments linked together to form a system that will analyze, record, and store ambient air data (figure 1). Once the structure to house the equipment is ready, the operator must obtain and install required instruments and supplies. For the sampling of ozone, all Ecology sites require;

- An ozone analyzer that has been certified by the EPA as an equivalent reference method.
- An ozone calibrator that has been checked against a primary ozone standard, referred to as an ozone transfer standard, for calibration and precision checks.
- FEP Teflon tubing for sampling lines, ¼ inch (outside diameter).
- A computer server and communication peripherals.
- Calibration report forms and log books.

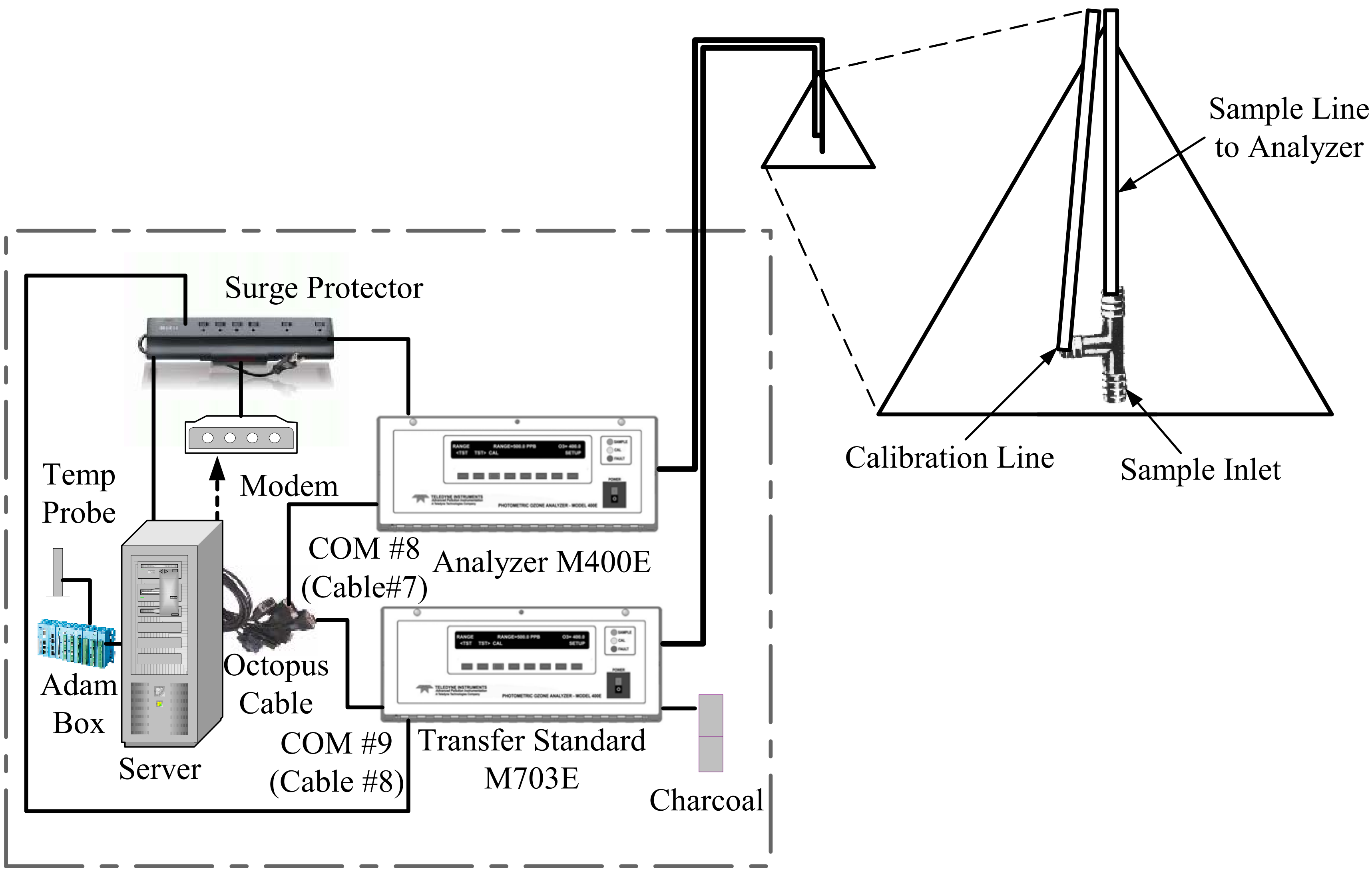


Figure 1 Station Installation

- An activated charcoal column to supply zero air. The column removes NO_2, O_3, hydrocarbons, and various other substances.

- An electronic temperature sensor connected to the server to monitor room temperature.

- The manufacturer's instrument manuals.

In order to collect data and perform necessary maintenance on the equipment, instruments should be placed in a shelter that provides easy access by the station operator. The instruments must not be located against heaters or air conditioners as they may affect their performance.

Station Inspection

A site operator should inspect each air monitoring station every two weeks. The purpose of inspection is to check the condition of the shelter and air monitoring instruments.

Before entering the station, the perimeter should be inspected for damage. Extreme weather conditions, neglected maintenance or vandalism may have resulted in damage to the site since the operator's last visit. Check that the sample probe is intact and has not been damaged.

3 CALIBRATION STANDARDS

In ambient air monitoring applications, precise ozone concentrations called standards are required for the calibration of ozone analyzers. 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 certified on site.

Ozone standards are classified into two basic groups: primary standards and transfer standards.

Primary Standards

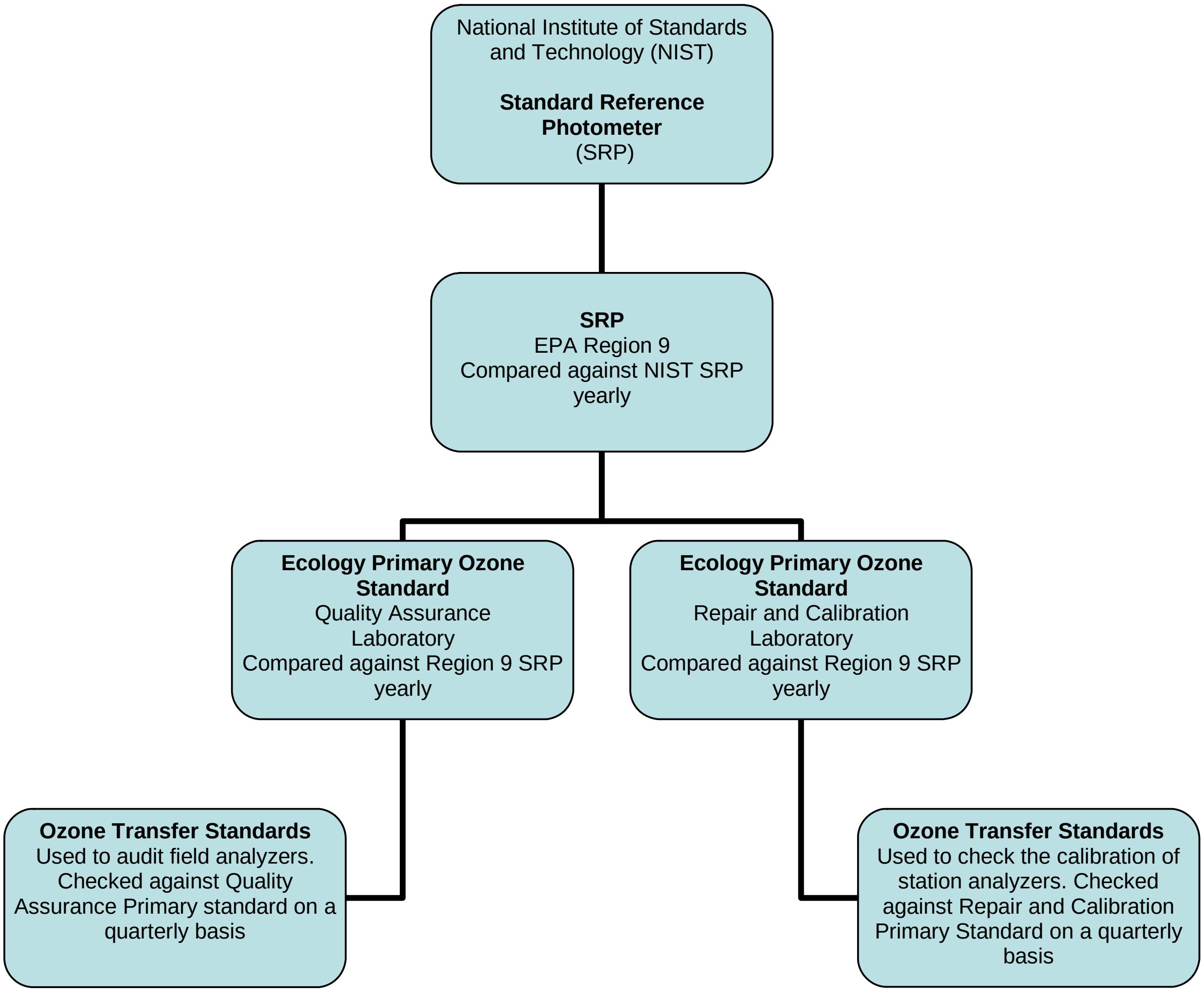
The primary standard is used to check the accuracy of ozone transfer standards and analyzers. An ultraviolet (UV) photometer is designated as the primary standard, recognized as the authority capable of generating and measuring ozone concentrations with impeccable accuracy. The concentrations generated by the designated primary ozone standard are recognized as the most accurate ozone concentrations available. It is required that the primary photometer used for the calibration of transfer standards be dedicated exclusively to such use, never used for ambient air sampling and maintained under meticulous conditions.

Ecology’s Primary Ozone Standards are compared against a Standard Reference Photometer in Region 9 on a yearly basis.

Transfer Standards

Transfer standards are used to calibrate the station "field" analyzer and to perform calibration checks. Instruments designated as transfer standards are used so the primary standard can remain at a fixed laboratory location where conditions can be carefully controlled and damage to the instrument minimized. Transfer standards are calibrated against the higher-level, primary standards. By using transfer standards, all of the ozone analyzer calibrations in Ecology's air monitoring network are related to the UV photometer designated as the primary standard. Figure 2 illustrates the ozone standards hierarchy.

Figure 2 Ozone Standards Hierarchy



Each transfer standard should have:

- A complete listing and description of all equipment, materials, and supplies necessary or incidental to the use of the transfer standard;
- A complete and detailed operational procedure for using the transfer standard, including all operational steps, specifications and quality control checks;
- Test data, rationale, evidence, and other information indications that the transfer standard meets the qualification requirements given;
- The current certification relationship information (slope and intercept) applicable to current use of the transfer standard, together with any corrections or restrictions in the operating conditions;

- A logbook including a complete chronological record of all certification and recertification data as well as all ozone analyzer calibrations carried out with the transfer standard.

- An activated charcoal column to supply zero air. The column removes NO_2, O_3, hydrocarbons, and various other substances;

- The manufacturer's manuals for the instruments.

Qualification, Certification and Recertification

The ozone instruments are calibrated by the Calibration and Repair Laboratory before each ozone season and should not require any physical adjustments during the ozone season.

Qualification consists of demonstrating that the transfer standard is sufficiently stable (repeatable) to be useful as a transfer standard. After a transfer standard has been shown to meet the qualification requirements, certification is required before it can be used.

Certification requires the averaging of six comparisons between the transfer standard and the UV primary ozone standard. Each comparison covers the full range of ozone concentrations. It is required that the primary standard generate six ozone concentrations on a different day. For each comparison, the slope (m) and intercept (I) is computed by a least squares linear regression and a preliminary calibration relationship is determined using the equations:

$$m\,(slope) = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}} \quad \text{.........................} \quad (1)$$

$$I\,(y\ intercept) = \bar{y} - m\bar{x} \quad \text{.........................} \quad (2)$$

When the comparisons are completed, the average slope from the six individual slopes is determined using the equation:

$$\bar{m} = \frac{1}{6}\sum_{i=1}^{6} m_i \quad \text{.........................} \quad (3)$$

The average intercept from the six individual intercepts is determined using the equation:

$$\bar{I} = \frac{1}{6}\sum_{i=1}^{6} I_i \quad \text{.........................} \quad (4)$$

The relative standard deviation of the six slopes (s_m) is determined using the equation:

$$s_m = \frac{100}{\bar{m}} \sqrt{\frac{1}{5} \left[\sum_{i=1}^{6} (m_i)^2 - \frac{1}{6} \left(\sum_{i=1}^{6} m_i \right)^2 \right]} \% \quad \text{.........................} (5)$$

The standard deviation measures the variation in the data set by determining how far the data values are from the mean, on the average. The value of s_m in equation 5 must be ≤ 3.7% to maintain certification.

The quantity (S_I) for the six intercepts is determined using the equation:

$$s_I = \frac{100}{\bar{m}} \sqrt{\frac{1}{5} \left[\sum_{i=1}^{6} (I_i)^2 - \frac{1}{6} \left(\sum_{i=1}^{6} I_i \right)^2 \right]} \quad \text{.............................} (6)$$

The value of S_I in equation 6 must be ≤ 1.5 to maintain certification.

Recertification involves periodic six point comparisons between the primary standard and the transfer standard. The linear regression slope of each new comparison must be within ± 5% of the average slope of the current certification relationship (i.e. the average slope of the last 6 comparisons). If the transfer standard meets the specification, a new slope and intercept is computed using the 6 most recent comparisons (running averages). The new calibration relationship is computed as:

$$\text{Standard } O_3 \text{ Concentration} = \frac{1}{\bar{m}} (\text{ Indicated } O_3 \text{ Concentration }) - \bar{I} \quad \text{............} (7)$$

Should the transfer standard fail the recertification specifications, it loses its certification and the problem must be investigated and corrected. Recertification requires repeating all the initial certification steps (six comparisons on different days). EPA recommends that a transfer standard which remains at a fixed monitoring site be recertified once per quarter if it is sufficiently stable to avoid loss of certification over that time period.

4 DATA QUALITY INDICATORS

Data Quality Indicators are qualitative and quantitative methods used to determine if the **Data Quality Objectives** of Ecology's Air Program are being satisfied. It is the responsibility of the station operator to take corrective action if the **Measurement Quality Objectives** are not being met.

Table 2 Data Quality Indicator

Data Quality Indicator	Frequency	Measurement Quality Objective	Corrective Action
Daily zero and precision check	Daily	**± 5%**	• Check for warning messages. • Visit site to correct. • Document reasons for failure.
Manual zero, precision and span check	Every 2 weeks	**± 5%**	• Contact the Calibration and Repair Laboratory. • Document reasons for failure.
Quality Assurance Ozone Audit	Within the 1st month of startup and end of ozone monitoring season	**± 7%**	• Discuss with auditor. • Determine and fix problem. • Request re-audit
National Performance Evaluation Program Audit	Once per season	**±10 %**	• Investigate, correct • Request Quality Assurance audit
Completeness	Continuous data 1-hour averages May-Sept	**80%**	• Contact Air Monitoring Coordinator

To meet these objectives, the station operator is required to visit the air monitoring station when the measurement quality objectives are not being met, at least once every two weeks, when audits are conducted or when monitoring instruments fail.

Calibration Checks

Calibration checks are quality control procedures used to verify that the air monitoring system is operating properly. The checks involve comparing the response of the station analyzer to ozone concentrations generated by the station transfer standard. The deviation between the "indicated" value of the analyzer and the "actual" or "true" value of the transfer standard is then determined.

Daily Automated Precision Check

The station transfer standard is preprogrammed to generate an automated two- point calibration every morning at 02:46 AM PST. The transfer standard is programmed to generate zero air for six minutes followed by an ozone concentration of 80 ppb for twenty minutes. The calibration is followed by a purge cycles, lasting two minutes. The operator is strongly encouraged to check the daily calibration results each morning to verify that the instrument is operating properly. If the difference between the analyzer and the calibrator is greater than ± 7 %, all ozone data going back to the last good precision check is “flagged" for invalidation. It is the operator's responsibility to investigate why the calibration check failed and note it in the electronic logbook.

Manual Zero, Precision and Span Check

Every two weeks the station operator should go to the monitoring station and perform a manually initiated calibration check on the station analyzer. The operator is required to check the instrument test functions, manually start the ozone transfer standard, and program it to generate zero air, ozone concentrations of 80 ppb (the precision) and 200 ppb (the span). While each concentration is measured by the transfer standard (the actual or true value) and the station analyzer (the indicated value), the operator records the measured responses on the Monthly Precision Check Summary Form (see Appendix).

A manual calibration check should never be performed on days when high ozone concentration is forecast for the region.

Following the manual calibration check, the deviation from the true ozone value is determined using the equation provided on the form. If the deviation is greater than ± 5%, the cause for the error must be investigated and corrected. If the results of the calibration check exceed the ± 7% limit, the data recovered since the previous calibration check is subject to invalidation. The results are compared to subsequent calibration checks to detect possible analyzer drift or a change in the response.

The station operator has the primary responsibility for distinguishing valid measurements from indications caused by malfunctioning instruments or source interferences.

Telemetry

The telemetry system is used by station operators to scan data transmitted from the monitoring station to a central location. This enables the operator to "call" the central location and examine the data recorded at the monitoring station (e.g. ozone concentrations and station temperature). The station operator should be familiar with daily concentration variations (i.e. the times daily maximum concentrations occur and the interrelationship of ozone). By recognizing abnormal data, the operator is alerted that the instruments may not be operating properly and a station visit may be necessary. However, monitoring a station by telemetry is not to be substituted for the bi-monthly station visit.

5 EQUIPMENT AND MAINTENANCE

It is the operator's responsibility to maintain the monitoring station. Routine maintenance includes keeping the interior and exterior of the shelter clean and being observant of potential problems. Examples of potential problems include:

- Water leaking into the structure;
- Shelter temperature exceeding the parameters;
- Accumulation of dirt and debris;
- Infestation by rodents or insects; and
- Overgrowth of vegetation around the shelter.

Each instrument must be periodically examined and serviced to anticipate and prevent instrument failure. Scheduled maintenance on the instruments will prevent costly repairs and loss of data. The routine maintenance required on the instruments by the station operator is minimal. By keeping track of the instruments responses from week to week, trends can be observed which would alert the operator of a potential problem and to correct the situation before the instrument fails.

Ecology's air monitoring network uses the Teledyne API M400E analyzer and M703E calibrator. Each instrument comes with a Teledyne operation manual.

Due to the reactivity of ozone, Ecology uses quarter inch (outside diameter) FEP Teflon tubing for the sample intake line. It is important that the sample line be as short as possible and kept clean. No matter how non reactive the sample line material is initially, after a period of use reactive particulate matter is deposited on the line walls. Dirt, insects, cobwebs, and moisture can accumulate in the sample line and on the sample intake filter. These contaminates absorb ozone in the ambient air sample as it flows through the sample line resulting in a reduced ozone concentration.

6 QUALITY ASSURANCE

Performance Audits

During each calendar quarter, utilizing the procedures and calculations specified in *40 CFR 58*, Appendix A, "Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS)," at least 25% of the operating automated analyzers will be audited.

System Audits

The systems audit is an on-site review and inspection of the entire ambient air monitoring program to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data. A systems audit will be performed annually by the Quality Assurance Coordinator. To provide uniformity in the evaluation, the criteria and procedures specified in EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume II, Section 2.0.11 will be applied.

7 DATA RECORDING, VALIDATION AND REPORTING

For detailed information on handling, recording, and validating air monitoring data, refer to *Ecology's Automated Method Data Documentation and Validation Procedures*.

All data will be reviewed using three tables of criteria, (where each table has a different degree of implication about the quality of the data) and certified by Quality Assurance prior to being reported or used to make decisions concerning air quality, air pollution abatement or control.

8 DATA QUALITY ASSESSMENT

For each calendar quarter and year, the Quality Assurance Unit will prepare data precision, accuracy and completeness reports for the Program Manager and EPA.

Precision

The precision will be evaluated and reported employing the frequencies, procedures and calculations in *40 CFR Part 58*, Appendix A, "Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS)".

Accuracy

Using results from the performance audits and the calculations specified in 40 *CFR 58*, Appendix A, "Quality Assurance Requirements for State and Local Air Monitoring Stations". The accuracy will be evaluated and reported.

Data Completeness

The completeness of the data will be determined for each monitoring instrument and expressed as a percentage. Percent valid data will be a gauge of the amount of valid data obtained from the monitoring instrument, compared to the amount expected under ideal conditions (24 hours per day, 365 days per year). Exceptions will be made for analyzers which have a seasonal sampling period, which were not installed at the beginning, or which were discontinued prior to the end of any reporting period for calculation purposes.

9 REFERENCES

1) *Air Pollution Training Institute, Course 435 Atmospheric Sampling, Student Manual, Second Edition*, Research Triangle Park, NC. 1983.

2) McElroy, F.F., *Transfer Standards for the Calibration of Ambient Air Monitoring Analyzers for Ozone*, Research Triangle Park, NC. 1979.

3) McElroy, F.F., R.J. Paur, *Technical Assistance Document for the Calibration of Ambient Ozone Monitors*, Research Triangle Park, NC. 1979.

4) Rehme, K.A., Smith C.F., and Paur, R.J., *Standard Reference Photometer for Verification and Certification of Ozone Standards User's Guide*, Research Triangle Park, NC. 1989.

5) Teledyne Instruments, *Instructional Manual Ozone Analyzer Model 400E*, San Diego, CA. 2006

6) Teledyne Instruments, *Operator's Manual Model 703E Photometric O_3 Calibrator*, San Diego, CA. 2006

7) Washington State Department of Ecology, Air Quality Program, *Site Selection and Installation Procedures*, Lacey, WA. Oct. 1993.

APPENDIX A OPERATING PROCEDURES

A.1 General Information

The Teledyne Air Pollution Instruments Model M400E Ozone Analyzer measures ozone in ambient air while the Model 703E Ozone Calibrator/Transfer Standard (referred to transfer standard thereafter in this document) is used only to check the calibration of the M400E. Both instruments are microprocessor controlled. The instruments require an environment where stable temperatures, pressures and flows be maintained in order to accurately measure ozone.

The instruments have the ability to reject interferences from SO_2, NO and H_2O. However, hydrocarbons and mercury vapor may cause problems for the instruments. Examples include hydrocarbons contained in dense smoke generated from a fire or mercury vapor from a broken mercury thermometer.

The front panels of the Teledyne API M400E ozone analyzer and M703E transfer standard look similar (Figure A.1 and A.2).

Figure A.1 Front panel Teledyne API M400E

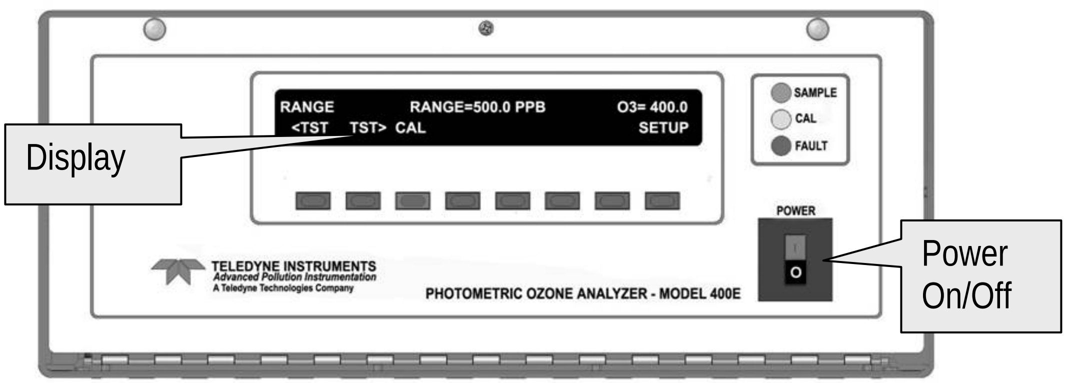
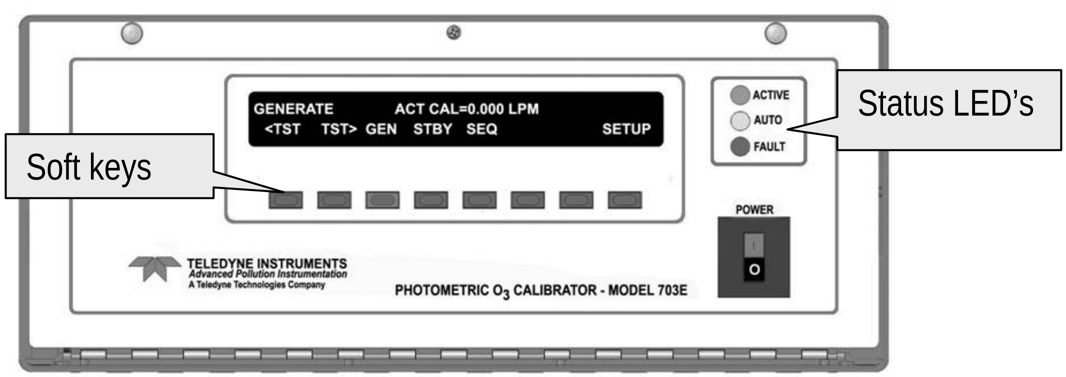


Figure A.2 Front Panel Teledyne API M703E



A.2 Inspection

Before installing the instruments, verify that there is no external or internal shipping damage and inspect the interior of the instruments to make sure all circuit boards and other components are in place.

Remove the top cover of the instrument (identical steps for either the analyzer or the transfer standard):

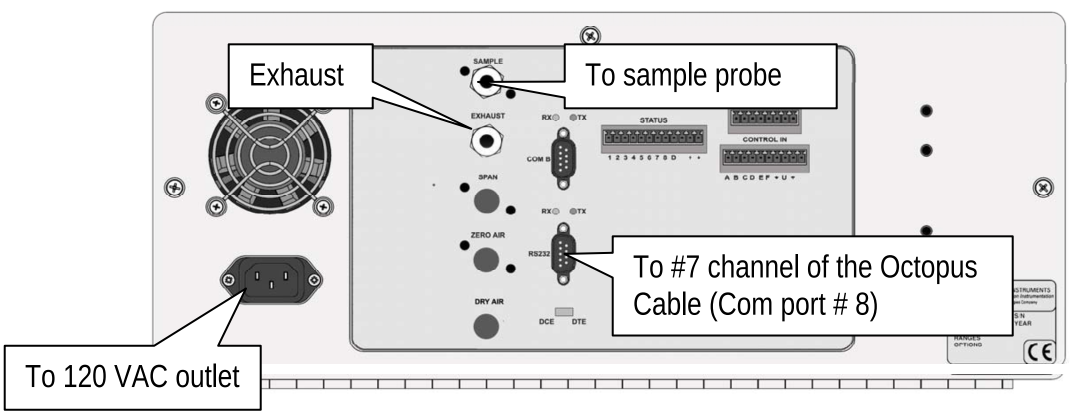
- Remove the set screw located in the top, center of the front panel (black, may have already been taken off);
- Remove the TWO screws fastening the top cover to the unit (one per side, stainless);
- Slide the cover back and lift the cover straight up.

If any damage is observed, contact Ecology's Calibration and Repair Laboratory.

A.3 Installation

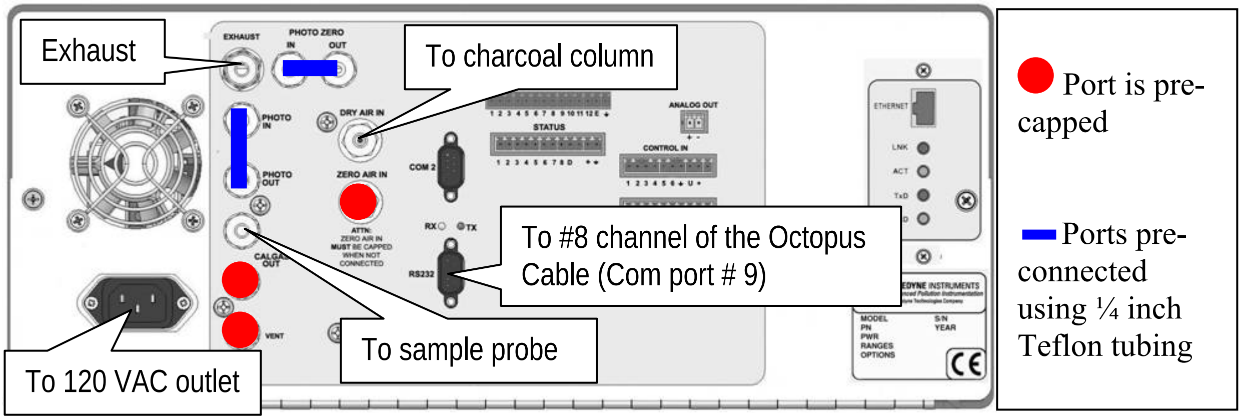
The instruments should be placed on a stable surface with at least 4 inches clearance in the back and 1 inch clearance for the sides, above and below. In order to prevent dust from getting into the gas flow lines, both instruments are shipped with small plugs inserted into each of the open inlets on the back panel. Remove these plugs and connect them as instructed below (Figure A.3 and A.4):

Figure A.3 API M400E Analyzer Rear Panel Connection



- Connect the SAMPLE port to the sampling line of the sample probe;
- Connect EXHAUST port to vent outside;
- Connect RS232 port to #7 channel of the Octopus Cable (COM port #8);
- Connect the power cords to the instruments and the male end of the cord to a 120 VAC surge protected power source.

Figure A.4 API M703E Transfer Standard Rear Panel Connection



- Cap one of the ports marked CAL GAS OUT, cap the VENT port, and cap the ZERO AIR IN port (done before shipment);
- Use a short length of ¼ inch Teflon tubing and fittings to connect the PHOTO ZERO IN port with the PHOTO ZERO OUT port (done before shipment);
- Use a short length of ¼ inch Teflon tubing and fittings to connect the PHOTO IN port with the PHOTO OUT port (done before shipment);
- Connect a charcoal column to the port marked DRY AIR IN;
- Connect one of the ports marked CAL GAS OUT to the calibration line of the sample probe;
- Connect EXHAUST port to a suitable vent outside;
- Connect RS232 port to a #8 channel of the Octopus Cable (COM port #9);
- Connect the power cords to the instruments and the male end of the cord to a 120 VAC surge protected power source.

Remember to:

- Always vent the exhaust to a suitable area where there is good ventilation.
- Never pressurize the instruments.
- Only use PTFE (Teflon), FEP or stainless for sample lines and fittings.
- Do not stack instruments.
- Make sure that air conditioners and heaters are not blowing directly on the instrument.

A.4 Operation

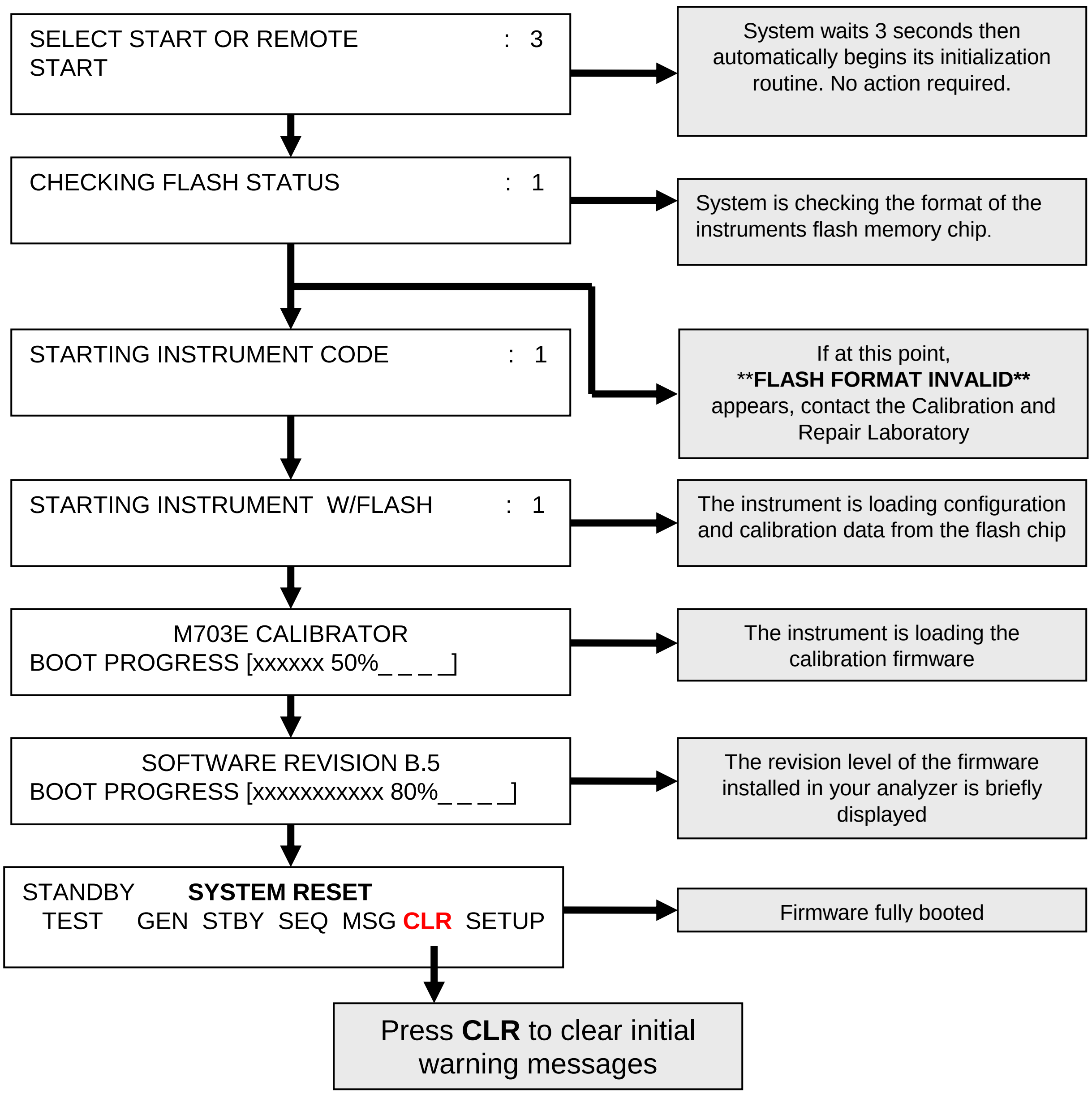
A.4.1 Startup

A.4.1.1 M703E Transfer Standard Startup

Once the instruments are turned on, the exhaust fan and pump will start and a single, horizontal dash will appear in the upper left corner of the instrument front display. This will last approximately 30 seconds while the CPU loads the operating system.

Once the CPU has completed this activity, it will begin loading the calibrator firmware and configuration data. During this process, string of messages will appear on the instruments front panel display (Figure A.5).

Figure A.5 Example of Model 703E Transfer Standard Startup

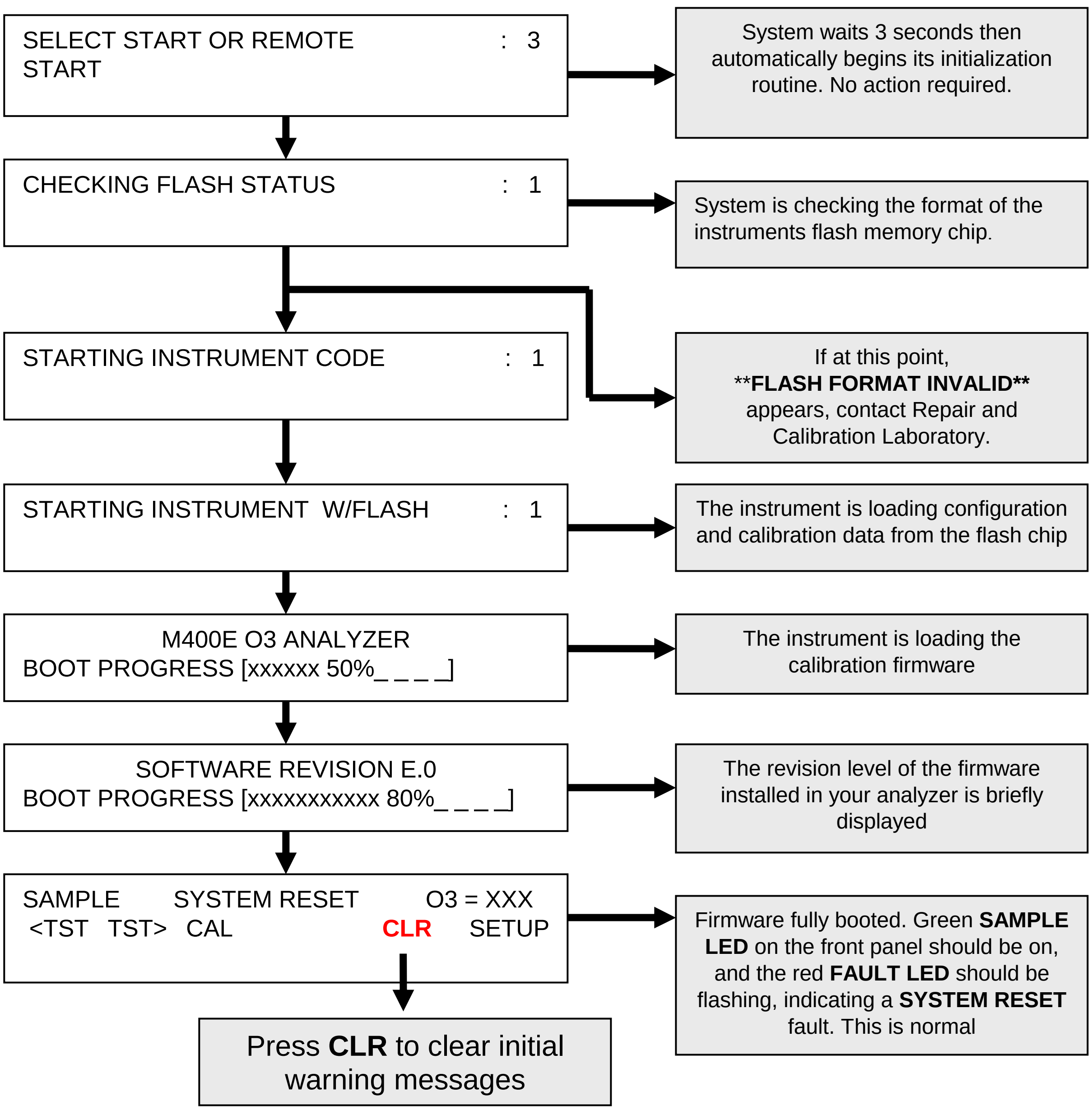


After completing the boot-up sequences and the **SYSTEM RESET** warning message has been cleared, the M703E calibrator should automatically switch to **STANDBY**. Because internal temperatures and other conditions may be outside the specified limits during the instrument warm-up period, the software will suppress most warning conditions for 30 minutes after power up. The instruments require about thirty minutes for all internal components to come up to temperature before reliable ozone measurements can be taken. The green **ACTIVE** Light Emitting Diode (LED) on the front panel should be on.

A.4.1.2 M400E Analyzer Startup

The M400E analyzer has the similar start-up screen as the M703E transfer standard (Figure A.6).

Figure A.6 Example of Model 400E Ozone Analyzer Startup

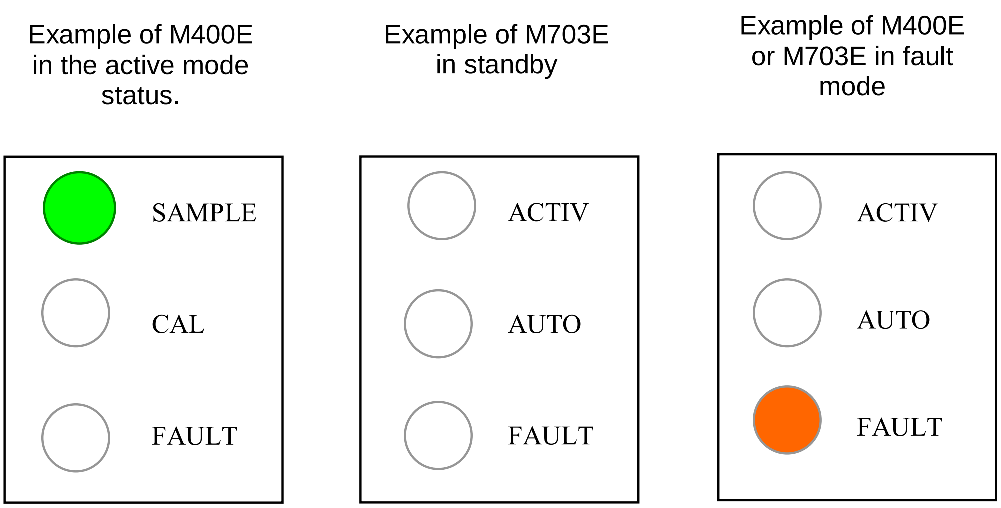


Press the **CLR** soft key to clear the **SYSTEM RESET** and the M400E analyzer should automatically switch to **SAMPLE** mode. The word **SAMPLE** in the upper left corner may flash on and off for several minutes as the unit warms up. The display may indicate a value of **XXXX** in the O_3 concentration field (upper right corner) when it is just turned on. It will show an actual concentration after 30 minutes. Because internal temperatures and other conditions may be outside the specified limits during the analyzers warm-up period, the software will suppress most warning conditions for 30 minutes after power up. The instruments require about thirty minutes for all internal components to come up to temperature before reliable ozone measurements can be taken. The green **SAMPLE** LED on the front panel should be on.

A.4.2 Status LED's

The Status LED's are located on the front panel of the instruments in the upper right corner. During normal operation, the M400E Sample LED will indicate green to indicate the instrument is operating properly (Figure A.7). No LED's on the M703E will be lit (as it is always in the standby mode) until a manual or automatic calibration is initiated. Whenever the M703E is activated (such as for a manual calibration check), the green ACTIVE LED on the M703E will be displayed.

Figure A.7 Status LED



The FAULT LED on both instruments should glow red only when first turning on the instruments and during the warm up period (usually this takes less than 30 minutes). The fault light should turn off once the fault message is cleared. If the red LED continues to flash a MSG warning, contact the Calibration and Repair Laboratory.

A.4.3 Instrument Test Functions

The test functions are viewed from the front panel and can be used to isolate and identify several operational problems when combined with a thorough understanding of the instruments (Figure A.8). Tables A.1 and A.2 list the most important test functions which the operator should check and record when performing a manual check. For the full list of test function, refer to the manufacture M400E manual Appendix A (Page A-18) and M703E manual Appendix A (Page A-17).

Figure A.8 Test Function Keys

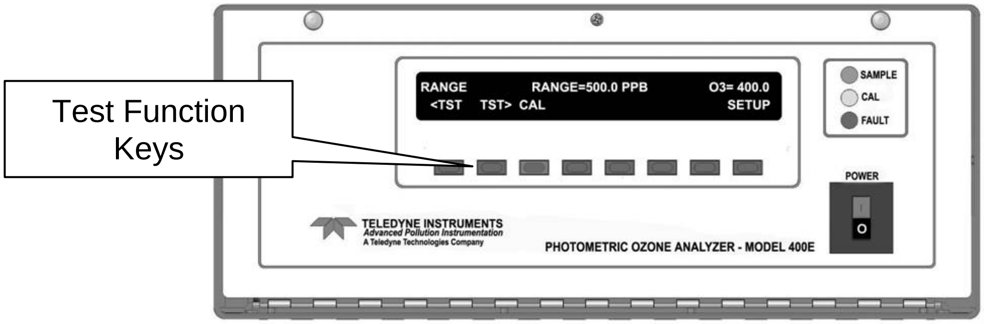


Table A.1 M400E Important Test Functions

Test Functions	Description	Acceptable limits
RANGE	Data range	500 ppb
STABIL	Concentration stability	<0.5 ppb
O3 REF	Photometer detector reference reading	3000-4800 mV
PRES	Sample pressure	27.0-29.9 In-Hg-A
SAMP FL	Sample flow rate	720-880 cc/min
BOX TEMP	Internal chassis temperature	20-40 ºC
SLOPE	Slope for current range, computed during zero/span calibration	0.85-1.15
OFFSET	Offset for current range, computed during zero/span calibration	0±3 ppb

Table A.2 M703E Important Test Functions

Test Functions	Description	Valid Range
ACT	Actual concentration being generated, computed from real-time inputs	Varies
TARG	Target concentration to generate	Varies
OUTPUT FLOW	Output flow rate	3.0-4.0 LPM
BOX TEMP	Internal chassis temperature	20-40 ºC
PHOTO REFERENCE	Photometer detector reference reading	3000-4800 mV
PHOTO FLOW	Photometer sample flow rate	0.72-0.88 LPM
PHOTO SPRESS	Photometer sample pressure	27.0-29.9 In-Hg-A
PHOTO SLOPE	Photometer slope computed during zero/span bench calibration	0.85-1.15
PHOTO OFFSET	Photometer offset computed during zero/span bench calibration	0±3 ppb

A.4.4 Backpressure

When first installing the M703E transfer standard, a zero check must be performed (see section A4.5.2). If the M703E indicates a stable but non-zero concentration when generating zero air, backpressure compensation to the M703E may be required. Contact the Calibration and Repair

Laboratory to perform site specific backpressure compensation diagnostic. This discrepancy experienced by the instrument is site specific but once corrected should compensate for any offsets the transfer standard experiences at the site due to pressure. If the M703E does not attain a stable zero, the Calibration and Repair Laboratory must be contacted to investigate the situation.

REMEMBER! THIS STEP NEEDS TO BE PERFORMED ONLY WHEN FIRST INSTALLING THE M703E AT A MONITORING SITE.

A.4.5 Zero, Precision and Span Check

The most important measurement quality objective is that the analyzer is operating properly. It is the responsibility of the station operation to check the status of the analyzer on a routine basis, either by computer or by physically going to the air monitoring station.

The manual quality control check requires the station operator to press specific keys on the M703E transfer standard to generate various ozone concentrations. The ozone concentrations are used to check the calibration of the M400E ozone analyzer. The corresponding readings must be recorded on the Calibration Check Sheet (Table A.3) and electronic logbook.

Table A.3 Calibration Check

Site Name: Cando Utoo **AIRS #:** 53-054-0001

Date: June 21, 2008 **Operator:** Jack Sparrow

Disabled at: 0900 **PST** **Enabled at:** 1045 **PST**

Transfer Standard SN#: 72 **Analyzer SN#:** 1349

Parameter	Range	Reading	Within Range
Output Flow (LPM)	3.0-4.0	3.4	√
Box Temp (°C)	20-40	31.1	√
Photo Reference (mV)	3000-4800	4485.8	√
Photo Flow (LPM)	0.72-0.88	.8592	√
Photo Pressure (In-Hg-A)	27.0-29.9	28.9	√
Photo Slope	See Cal. Sheet	1.006	√
Photo Offset (ppb)	See Cal. Sheet	-0.8	√

Parameter	Range	Reading	Within Range
O3 REF (mv)	3000-4800	4312.0	√
PRES (in-Hg-A)	27.0-29.9	27.9	√
SAMP FL (cc/m)	720-880	767	√
BOX TEMP (°C)	20-40	27.7	√
Slope	See Cal. Sheet	1.024	√
Offset (ppb)	See Cal. Sheet	-0.7	√
Please mark here if a filter is changed			√

Setting (ppb)	ANALYZER		TRANSFER STANDARD	Difference[2] (%)
	Stability[1] (ppb)	Indicated (ppb)	Actual (ppb)	
0	0.3	1.1	0	N/A
80	0.2	83.2	80	4.0
200	0.1	207.1	200	3.6

[1]Stability should ≤ 0.3 ppb

[2]Difference (%) = $\frac{\text{Analyzer Indicated} - \text{Transfer Standard Actual}}{\text{Transfer Standard Actual}} \times 100\%$

The difference must be within ± 7%. If it is greater than ± 5%, the cause needs to be investigated. Contact the Calibration and Repair Laboratory for assistance.

Information in the last table (Shaded) should be recorded into the electronic log book along with your routine maintenance information (e.g. cleaning the line, changing the filter, etc.).

A.4.5.1 Offscan channels

Once at the station, check the status LED of the M400E. The Green LED on the M400E should be on, while on the M703E no LED's will be on as the M703E should be in the **STDBY** mode.

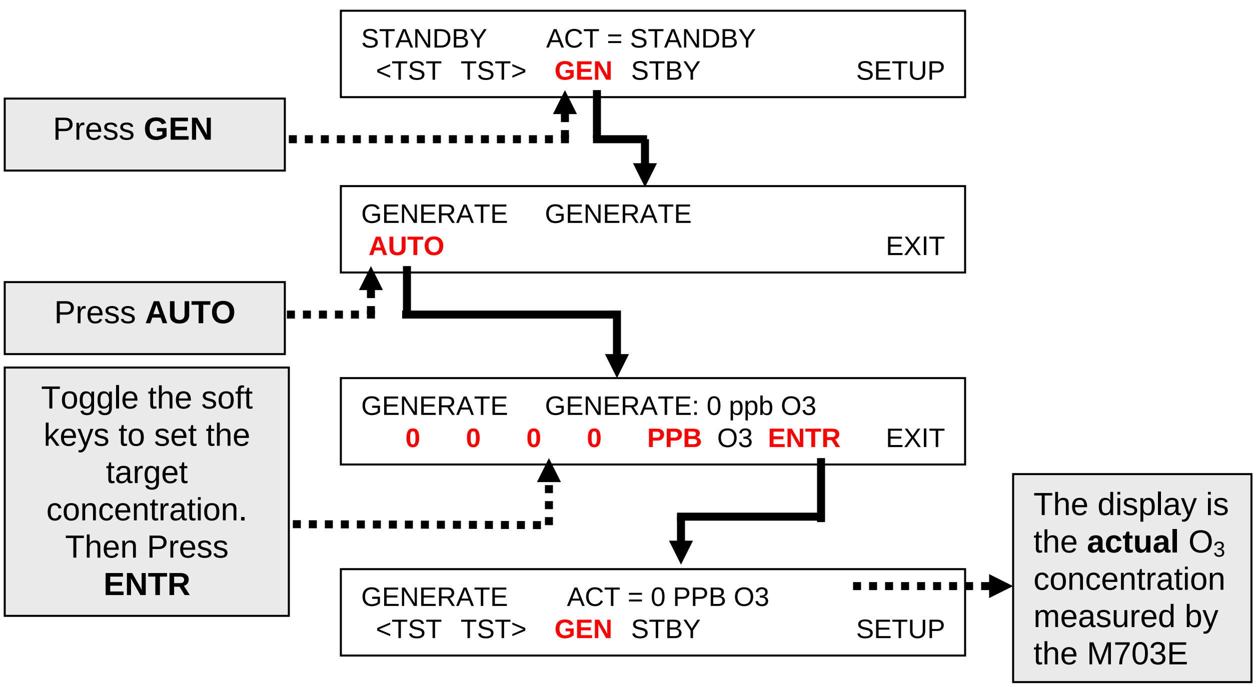
Please OFFSCAN O3 (Channel 6), O3 TS ACT CONC (Channel 19) and O3 TS TARG CONC (Channel 20) on ENVIDAS DYNAMIC TABULAR through your laptop before you perform a manual calibration check and other maintenances listed in the A.5 section. Set all channels back to ORIGINAL before leaving the site.

A.4.5.2 The zero check

Begin the quality control check control by pressing **GEN** on M703E followed by **AUTO** then **0 0 0 0 ppb O3** **ENTR** to generate clean (zero) air (Figure A.9)

After **ENTR** is pressed, the pump in the M703E draws in ambient air purified by the external activated carbon column. The charcoal column should sufficiently cleanse the air of contaminants likely to cause a detectable response on the analyzer.

Figure A.9 Generating Zero Air



Once both instruments stabilize, use the Calibration Check Sheet to record the concentration displayed by the M703E and the M400E in the "0 ppb" line. The stability can be judged by toggling **<TST TST>** soft key on M400E analyzer till **STABIL** is displayed. If **STABIL** reading is less than 0.3 ppb, both instruments are considered to be stable. The displayed concentrations on the analyzer (**O3=**) and transfer standard (**ACT**) together with the stability (**STABIL**) reading shown on the analyzer should be recorded on the calibration check sheet.

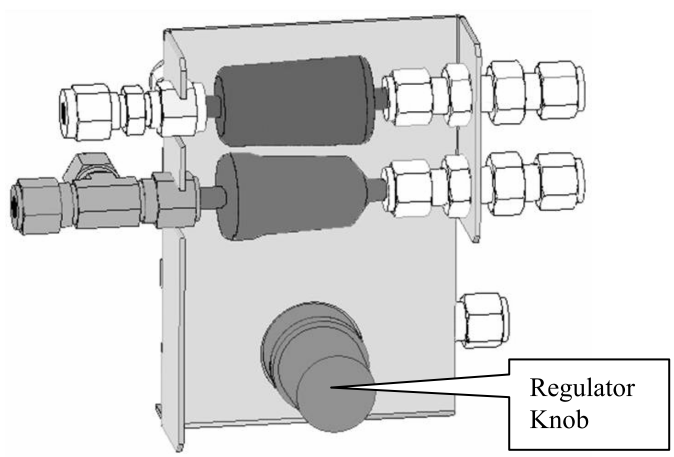
The output flow generated by the M703E is preset in the laboratory and can be checked by pressing the **<TST TST>** soft key several times until **OUTPUT FLOW** is displayed.

The minimum output flow should equal the flow requirements of the ozone analyzer being checked plus at least 1.0 LPM excess flow. If the analyzer to be calibrated has a flow of 800 cc/min, the proper **OUTPUT FLOW** of the M703E should be set at a minimum of 2.6 LPM. (1 LPM + 800 cc + 800 cc = 2.6 LPM). The transfer standard must run between 3-4 LPM with best around 3.5 LPM. If the flow rate is outside of range, adjust the output flow rate.

- **SETTING THE M703E'S OUTPUT FLOW RATE:**

1. Open the front panel of the calibrator down by releasing the two snap-in fasteners at the top of the front panel;
2. Pull out the regulator knob (Figure A.10) and adjust the regulator until the desired flow (~3.5 LPM) is achieved. (Clockwise: increase flow rate; Counterclockwise: decrease flow rate);

Figure A.10 Regulator Knob



3. Push the regulator knob back in to lock;
4. Close the front panel.

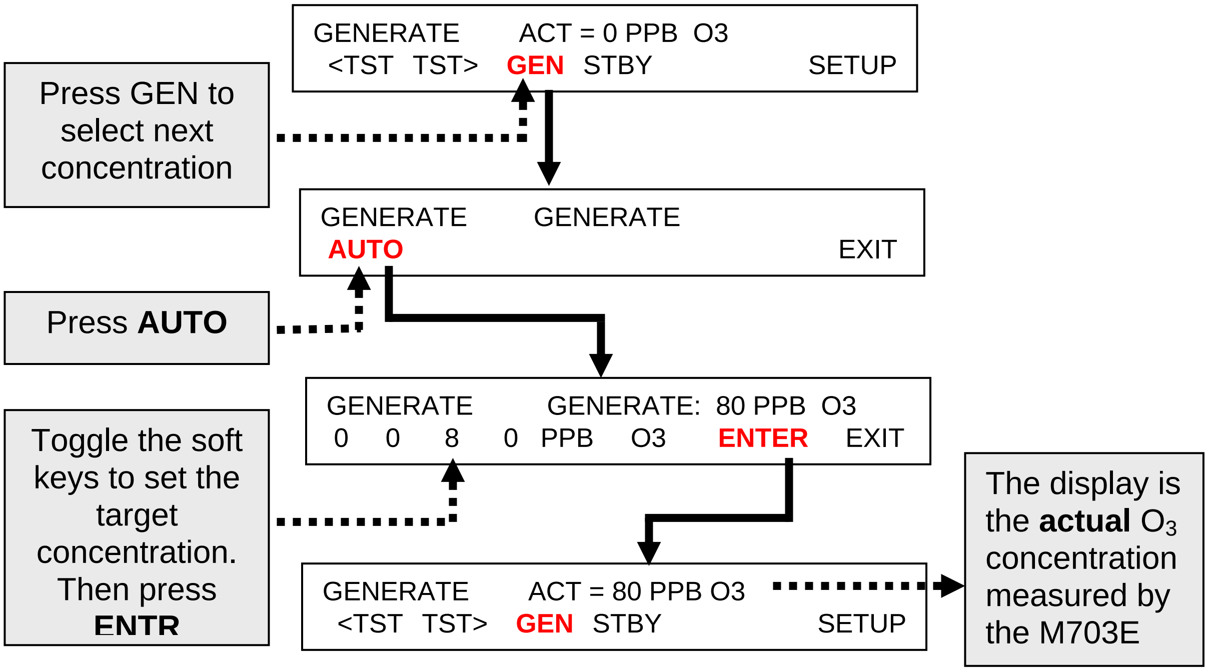
A.4.5.3 The precision/span check

Once the zero air values have been recorded, press **GEN** to select the next concentration.

The next concentration to be generated is 80 ppb (Figure A.11). Press **GEN** followed by **AUTO**. Toggle the soft keys to the target concentration of 0080 ppb then press **GEN**.

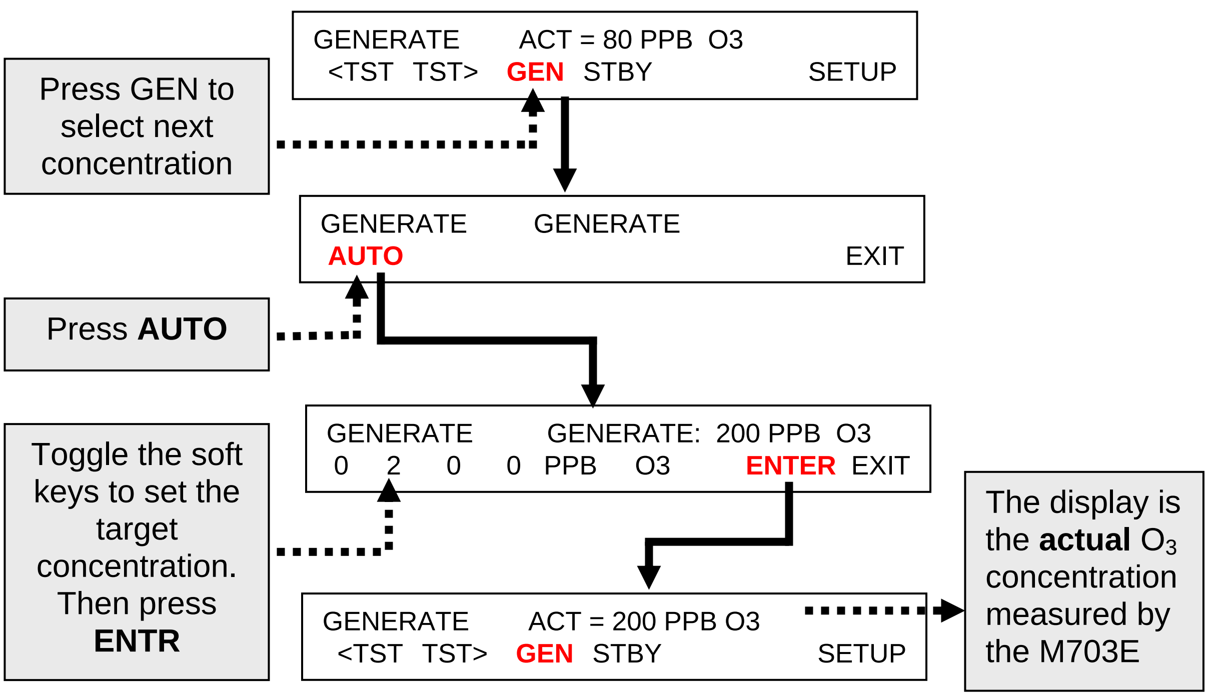
Once both instruments stabilize, use the Calibration Check Sheet to record the concentration displayed by the M703E and the M400E in the "80 ppb" line. The stability can be judged by toggling **<TST TST>** soft key on M400E analyzer till **STABIL** is displayed. If **STABIL** reading is less than 0.3 ppb, both instruments are considered to be stable. The displayed concentrations on the analyzer (**O3=**) and transfer standard (**ACT**) together with the stability (**STABIL**) reading shown on the analyzer should be recorded on the calibration check sheet.

Figure A.11 Generating 80 ppb Ozone



The final concentration to be generated is 200 ppb (Figure A.12). Press **GEN** followed by **AUTO**. Toggle the soft keys to the target concentration of 0200 ppb then press **GEN**.

Figure A.12 Generating 200 ppb Ozone



Once both instruments stabilize, use the Calibration Check Sheet to record the concentration displayed by the M703E and the M400E in the "200 ppb" line. The stability can be judged by toggling **<TST TST>** soft key on M400E analyzer till **STABIL** is displayed. If **STABIL** reading is less than 0.3 ppb, both instruments are considered to be stable. The displayed concentrations on the analyzer (**O3=**) and transfer standard (**ACT**) together with the stability (**STABIL**) reading shown on the analyzer should be recorded on the calibration check sheet.

After finishing the precision check, please press STBY. Otherwise, the M703E will continue to generate ozone until the STBY button is pressed.

Determine the difference between the analyzer and the transfer standard using the equation in the Calibration Check Sheet. If the difference is greater than ± 5% or if the zero reading is greater than ± 3 ppb, the Calibration and Repair Laboratory should be notified. If the results of the calibration check exceed ± 7%, the data recovered since the previous calibration check is subject to invalidation. Once the problem is identified and corrected, a calibration check must be performed to demonstrate that the system is operating properly.

A.5 Maintenance

Major maintenance and repairs on the instruments will be performed at the Calibration and Repair Laboratory in the Ecology headquarters. However, the station operator is still required to perform a minimum amount of routine maintenance on the instruments. The maintenance is required to be recorded in the electronic log book.

A.5.1 Cleaning/Replacing the Sample Lines

A routine cleaning or replacement of the sample lines is required before the beginning of the ozone monitoring season or if the operator suspects a loss in ozone concentrations due to contamination.

To clean the sample lines, disconnect the Teflon tubing from the port marked **CAL GAS OUT** on the M703E transfer standard and the port marked **SAMPLE** on the M400E analyzer. Inject both lines with a soapy water solution (a syringe works well) and push the liquid through the line using a small pump, air compressor or cylinder air. Do this process several times and then flush the lines with clean water. Using the clean air source, blow air through the tubing for several minutes to remove all the water from the sample lines and then reconnect the tubing to the instruments. Condition the probe by generating an ozone concentration of 800 ppb for at least 30 minutes (the length of time may vary due to the length of the inlet probe). This procedure is followed by a span check at 200 ppb to confirm that the sample line has been properly conditioned and the analyzer and transfer standard agree (≤ ±5%).

A.5.2 Replacing the Particulate Filter

A Teflon filter is used to keep dirt from entering the analyzer. The filter must be checked during each station visit and changed when it becomes noticeably dirty. Slow analyzer response during a calibration check may indicate a dirty filter.

The Teflon filter is located inside the analyzer and the filter holder is mounted to the left side of the front panel. It is accessed by removing the Phillip-head screw at the top-center of the front panel. Pull the two black pegs on the top of the front panel of the analyzer until the front panel opens allowing the front panel to fold down.

To replace the Teflon filter (Figure A.13);

1. Unscrew the black rim around the glass piece and remove the glass cover;
2. Remove the large o-ring and cut-outs that holds the filter in place;
3. Remove the old filter and replace with a new filter, **paying attention to place the Teflon coated side of the filter downward in the holder**;
4. Place the cut-out and o-ring on the filter;
5. Place the glass cover on the o-ring and screw the black rim onto the filter holder;
6. Lift the front cover to close the instrument by pushing the black pegs into place.

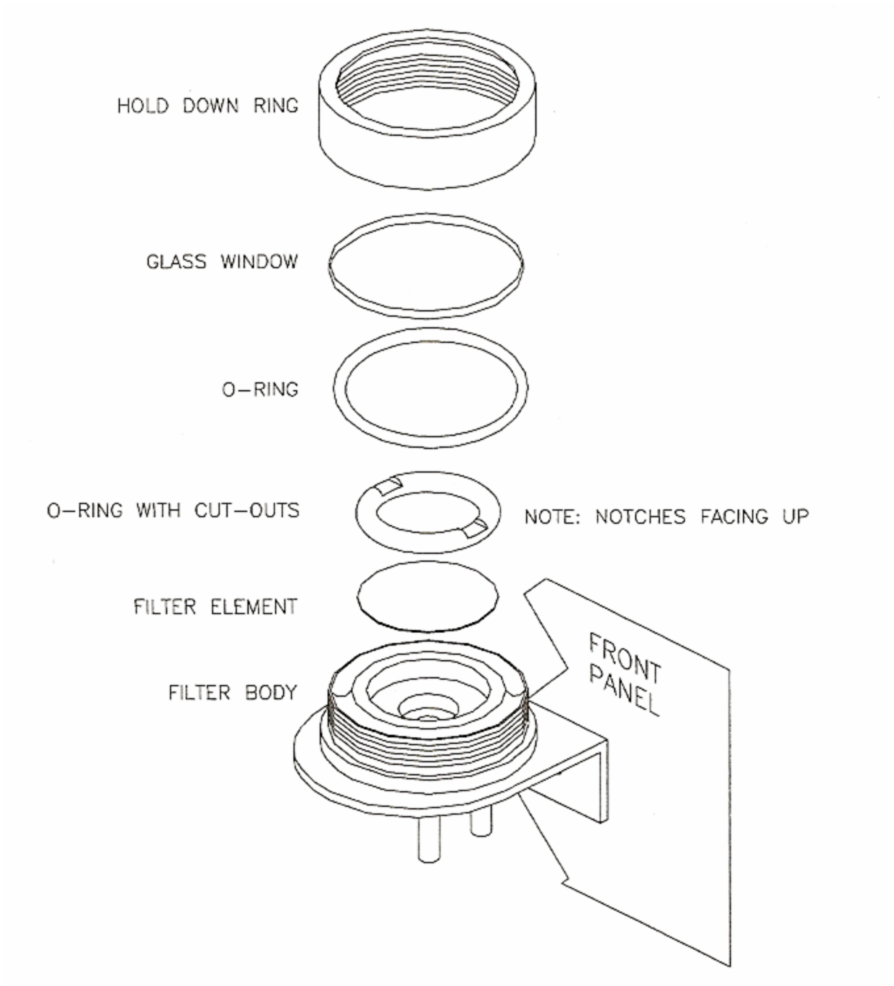


Figure A.13 Replacing the Particulate Filter

After changing the filter, it is recommended to perform a leak check to make sure that filter is sitting well in its housing.

1. Turn the analyzer ON, and allow enough time for flows to stabilize;

2. Cap the sample inlet port with a **Teflon Cap** (Do not use a metal cap);

3. After 2 minutes, when the pressures have stabilized, note the SAMP FL test function reading on the front panel (toggle the **<TST TST>** key till **SAMP FL** appears on the screen);

4. If SAMP FL < 10 CC/M then the analyzer is free of any large leaks.

A concentration of 800 ppb is required to be generated by the ozone transfer standard for approximately 30 minutes to remove any potential contaminations on the particulate filter. This procedure is followed by a span check at 200 ppb to confirm that the filter has been properly conditioned and the analyzer and transfer standard agree (≤ ±3%).

A.5.3 Adjusting the UV Source lamp

This procedure should be done whenever the O3 REF (M400E analyzer) or Photo Reference (M703E transfer standard) value drops below 3000 mV.

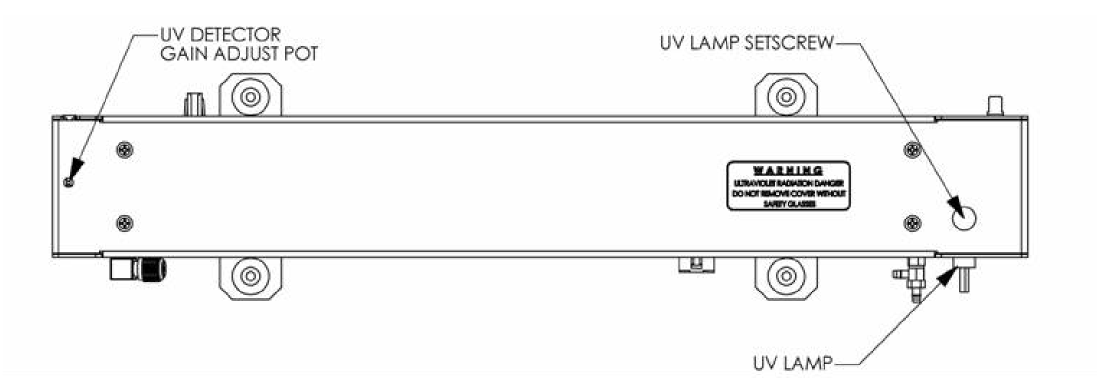
1. Make sure the analyzer/transfer standard is warmed-up and has been running for at least 15 minutes before proceeding;

2. Remove the cover from the analyzer/transfer standard (please see A.2 instruction to remove the cover);

3. Locate the Optical Bench Assembly inside of analyzer/transfer standard;

4. Locate the UV DETECTOR GAIN ADJUST POT on the photometer assembly (at the rear of the optical bench for M400E analyzer while at the front of the optical bench for M703E transfer standard) (Figure A.14);

Figure A.14 Optical Bench



5. Perform the following procedures to bring PHOTO_DET to the front screen (Figure A.15 and A.16):

Figure A.15 Steps to Bring PHOTO_DEC for M400E Analyzer

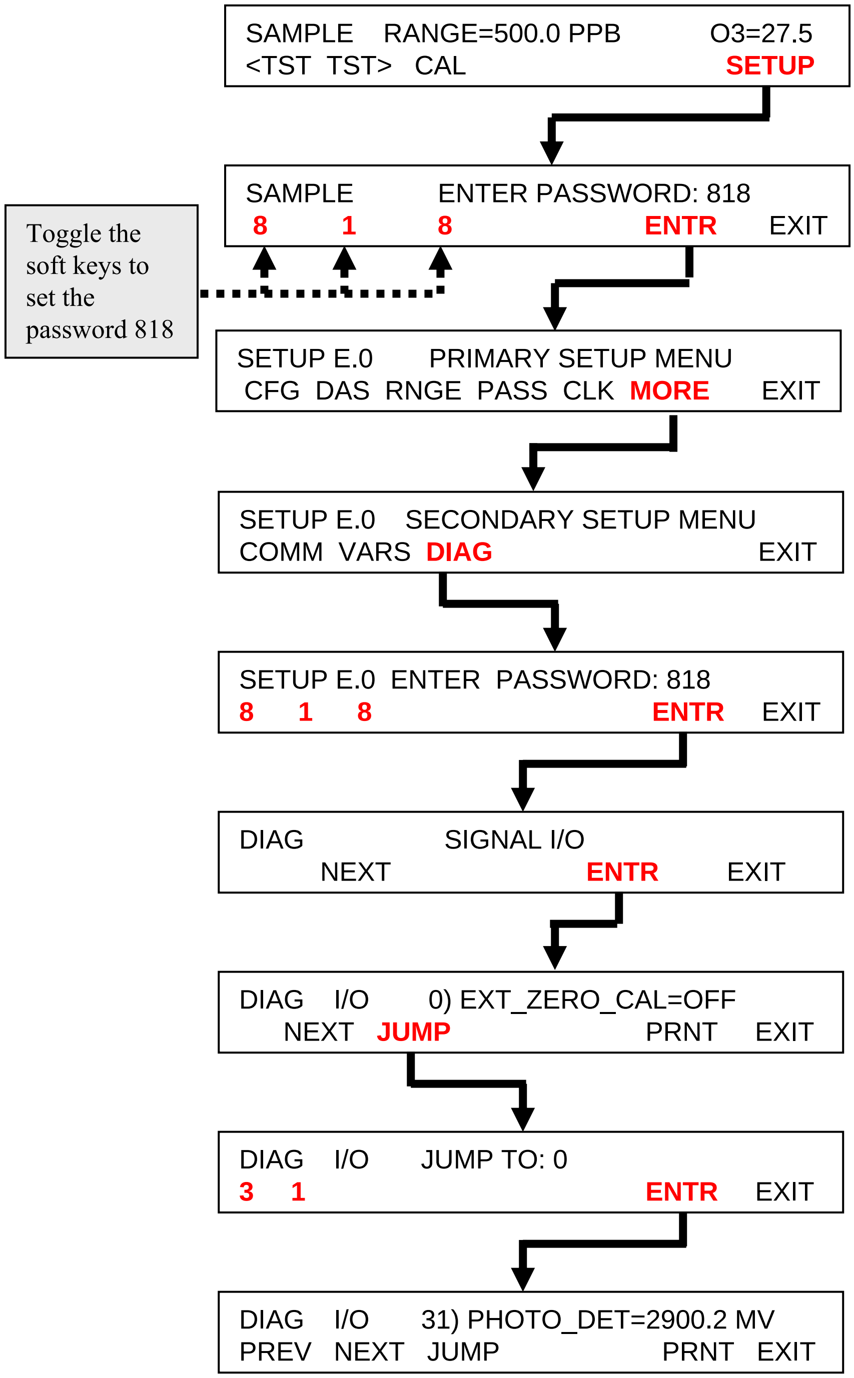
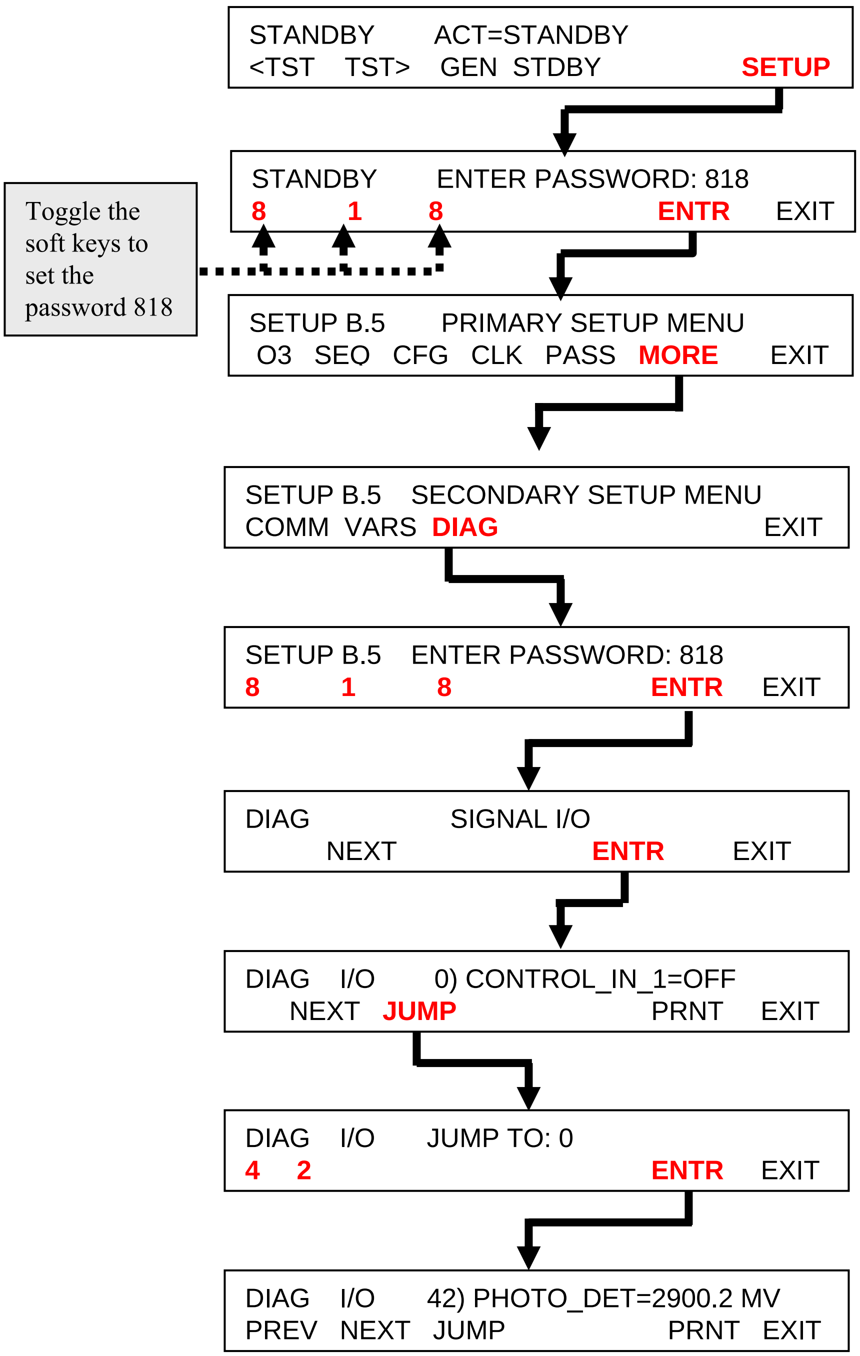


Figure A.16 Steps to Bring PHOTO_DEC for M703E Analyzer



6. Using an insulated pot adjustment tool, turn the UV DETECTOR GAIN adjustment pot counter-clockwise to increase the PHOTO_DET signal. The target is to adjust PHOTO_DET as high as possible within the range of 3500-4600 mV;

7. (Option) If necessary, additional adjustment can be made by physically rotating the lamp in its housing. To do this, slightly loosen the UV LAMP SETSCREW. Next, slowly rotate the lamp up to ¼ turn in either direction while watching the PHOTO_DET signal. TO finish, re-tighten the LAMP SETSCREW;

8. If the 3500-4600 mV range cannot be reached by either of the adjustment methods in step 6 and 7, then the lamp must be replaced. Please call Calibration and Repair laboratory for the new lamp and following next section to replace the lamp;

9. Replace the cover on the instruments and press EXIT key on the front panel till to the main interface.

A.5.4 Replacing the UV Source lamp

If the lamp can no longer be adjusted as described in A.5.3 or seems to be noisy (judged when both the Photo Reference and Photo Measure are moving around), the lamp has to be replaced.

1. **TURN THE ANALYZER/TRANSFER OFF!**

2. Remove the analyzer/transfer standard cover.

3. Locate the Optical Bench Assembly.

4. Locate the UV lamp at front or rear of the optical bench assembly (M400E: Front; M703E: Rear).

5. Unplug the lamp cable from the power supply connector on the side of optical bench;

6. Slightly loosen (but do not remove) the UV LAMP SETSCREW and pull the lamp from its housing.

7. Install the new lamp in the housing, pushing it all the way in. Do not tighten the setscrew.

8. Turn the analyzer/transfer standard back on and allow to warm up for at least 15 minutes;

9. Turn the UV DETECTOR GAIN ADJUSTMENT POT clockwise to its **MINIMUM** value. The pot should click softly when the limit is reached.

10. From the front panel, following A.5.3 Step 5 to bring PHOTO_DET signal displayed.

11. While watching the PHOTO_DET signal, slowly rotate the lamp in its housing (up to ¼ turn in either direction) until a **MINIMUM** value is observed. Make sure the lamp is pushed all the way into the housing while performing this rotation. Tighten the LAMP SETSCREW at the approximate minimum value observed.

12. Adjust the UV DETECTOR GAIN ADJUSTMENT POT counter-clockwise to increase PHOTO_DET signal within the range of 4400-4600 mV.

13. Replace the cover on the instruments and press EXIT key on the front panel till to the main interface.

NOTE: Please put the bad UV lamp into the replacement lamp box and write down the instrument model number and serial number. **PLEASE SHIP THE BAD LAMP BACK TO CALIBRATION AND REPAIR LAB. DO NOT DISPOSE OF IT.**

A.6 Troubleshooting and Faults

The most common and/or serious instrument failures will result in a blinking red **FAULT LED** and a **MSG** warning displayed on the front panel. The warning message is displayed by pressing the **MSG** soft key (Figure A.17). To check for message and to clear the M400E or the M703E:

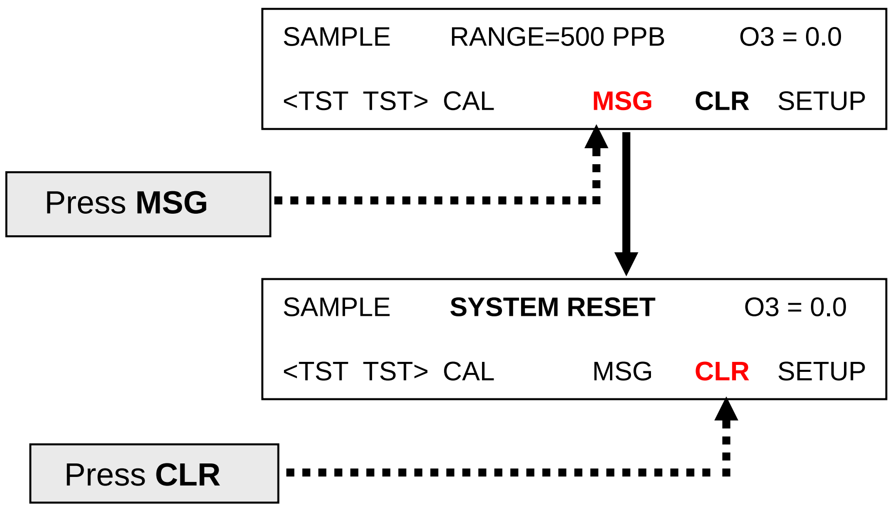


Figure A.17 Clearing Fault Message

The instruments are capable of displaying several warning messages (Table A.4 and A.5). Please refer to the instrument manuals for a list of warning messages (M400E page 249 and M703E page 177). If there are more than two warning messages occurring at the same time, please contact Calibration and Repair Lab as it is often an indication that a major failure of the instrument has occurred.

Table A.4 Common Warning Message for M400E Analyzer (Full list in manual on p 250)

Warning message	Fault Condition	Possible Causes
BOX TEMP WARNING	Box Temp is <5 ºC or > 48 ºC	• Poor/blocked ventilation • Stopped exhaust-fan • Ambient temp outside of specified range
LAMP STABIL WARN	Reference value is unstable	• Faulty UV source lamp • Noisy UV detector • Faulty UV lamp power supply
SAMPLE FLOW WARN	Sample flow rate is < 500 cc/min or > 1000 cc/min	• Failed sample pump • Blocked sample inlet/gas line • Dirty particulate filter • Leak downstream of critical flow orifice • Failed flow sensor
SAMPLE PRES WARN	Sample pressure is < 15 in-Hg or > 35 in-Hg; Normally 29.92 in-Hg at sea level decreasing at 1 in-Hg per 1000 ft of altitude (with no flow – pump disconnected) `1	If sample pressure is < 15 in-Hg: • Blocked particulate filter • Blocked sample inlet/gas line • Failed pressure sensor or circuitry If sample Pressure is >35 in-Hg: • Bad pressure sensor/circuitry
SAMPLE TEMP WARN	Sample temperature is < 10 ºC or > 50 ºC	• Ambient temperature outside of specified range • Failed sample temperature sensor • Others (refer the manual)
PHOTO REF WARNING	Occurs when REF is <2500 mV or > 4950 mV	• UV lamp • UV Photo-Detector Preamp

Table A.5 Common Warning Message for M703E Transfer Standard (Full list at manual p 177)

Warning message	Fault Condition	Possible Causes
PHOTO LAMP STABILITY WARNING	Value output during the photometer's reference cycle changes from measurements to measurement more than 24% of the time	• Faulty UV source lamp • Noisy UV detector • Faulty UV lamp power supply • Faulty ± 15 VDC power supply
PHOTO REFERENCE WARNING	Occurs when REF is <2500 mV or > 4950 mV	• UV lamp • UV Photo-Detector Preamp

Appendix B Ozone Critical Criteria, Operational, Systematic Criteria Tables

Observations that do not meet each and every criterion on the Critical Criteria Table should be invalidated unless there are compelling and justification for not doing so. The sample or group of samples for which one or more of these criteria are not met is invalid until proven otherwise. The cause of not operating in the acceptable range for each of the violated criteria must be investigated and minimized to reduce the likelihood that additional samples will be invalidated.

OZONE CRITICAL CRITERIA TABLE			
Criteria	**Acceptable Range**	**Frequency**	**40 CFR QA Guidance Reference**
Standard Reporting Units	ppm	All data	40 CFR, Pt 50.9
Completeness (seasonal)			
Maximum 1-hour concentration	75% values from 9:01 AM to 9:00 PM (LST)	Daily	40 CFR, Pt 50, App H, S 3
Precision			
Single analyzer	.080 - 100 ppm	1/ 2 weeks for seasonal sites or sites where manual QC checks are performed 1/4 weeks at year round automated sites	40 CFR, Pt 58, App A
Reporting organization	1/3 months	95% CI <15%	EPA-600/4-83-023 Vol II, App 15, S 6
Accuracy			
Single analyzer	None	25 % of sites	40 CFR, Pt 58, App A
Annual accuracy	95% CI <20%	quarterly (all sites yearly)	EPA-600/4-83-023 Vol II, App 15, S 6
Quality Control Check Zero/span check -level 1 If Cal updated at each zero/span	Zero drift <20 to 30 ppb Span drift <20 to 25 %	1/ 2 weeks	Vol II, S 12.6
Zero/span check -level 1 If fixed Cal used to calculate data	Zero drift <10 to 15 ppb Span drift < 15%	1/ 2 weeks	Vol II, S 12.6

Criteria that are important for maintaining and evaluating the quality of the data collection system are included on the Ozone **Operational Evaluation Table**. Violation of a criterion or a number of criteria may be cause for invalidation. The decision should consider other quality control information that may or may not indicate the data are acceptable for the parameter being controlled.

OZONE OPERATIONAL TABLE

Criteria	Acceptable Range	Frequency	40 CFR QA Guidance Reference
Shelter Temperature			
Temperature range	20° to 30° C. (Hourly average) or Instrument must be operated per manufacturers specifications	Daily (hourly values)	40 CFR, Pt. 53.20Vol II, S 7.1
Temperature control	< 2° C	Daily	
Ozone analyzer calibration			
Multipoint calibration (at least 5 points	Linearity error <5%	Upon receipt, adjustment, or 1/year if cont. zero/span 1/ 6 months if manual zero/span	40 CFR, Pt 50, App D, S 5.2.3 EPA-600/4-79-057 S.5 Vol. II, S 12.2
Residence Times	Required to be < 20 seconds from sample inlet to sample port of instrument. Recommended to be < 10 seconds.		*40 CFR, Pt 58, App E, S 9.0* *Quality Assurance Handbook for Air Pollution Measurement Systems Volume II: Part 1, Section:7*
Zero Air	Free of any substance that might react with ozone		
Performance Evaluation			
(NPAP)	Mean absolute difference <15%	1/year at selected sites	Vol. II, S 16.3
State audits	State requirements	1/year	Vol II, App 15, S 3

Criteria important for the correct interpretation of the data but do not usually impact the validity of a sample or group of samples is included on the **Ozone Systematic Criteria Table**. For example, the data quality objectives are included in this table. If the data quality objectives are not met, this does not invalidate any of the samples but it may impact the error rate associated with the attainment/non-attainment decision.

OZONE SYSTEMATIC CRITERIA TABLE

Criteria	Acceptable Range	Frequency	40 CFR Reference QA Guidance Reference
Detection			
Noise	3 ppb		40 CFR, Pt. 53.20 & 23
Lower detectable level	3 ppb		“
Transfer standard			
Qualification and certification	< 4% or <4 ppb (whichever greater) RSD of six slopes < 3.7%	Upon receipt of transfer standard	EPA-600/4-79-056
Recertification to local primary standard	Std. Dev. of 6 intercepts 1.5 New slope = ± 0.05 of previous	Beginning and end of O3 season or 1/6 months whichever less	EPA-600/4-79-057
Local primary standard			
Certification/recertification to Standard Photometer	Difference < 5 % (Preferably < 3%)	1/year	*Determination of O3 by Ultraviolet Analysis (draft)*
(if recertified via a transfer standard)	Regression slopes = 1.00 ± 0.03 and two intercepts are < 3 ppb	1/year	“
EPA Standard Reference Photometer recertification	Regression slope = 1.00 ± 0.01 and intercept < 3 ppb	1/year	Protocol for Recertification of Standard Reference Photometers
Siting Criteria	Appropriate to Scale		40 CFR Part 58
Equipment			
O3 Analyzer	Reference or Equivalent Method		40 CFR Part 53.9 EPA 600/4-079-057

Appendix C Calibration Check Form

Site Name ____________________________ **AIRS #**________________________________

Date_________________________________ **Operator**_______________________________

Disabled at: ______________________**PST** **Enabled at:** ________________________ **PST**

Transfer Standard SN#_____________ **Analyzer SN#**________________

Parameter	Range	Reading	Within Range
Output Flow (LPM)	3.0-4.0		
Box Temp (°C)	20-40		
Photo Reference (mV)	3000-4800		
Photo Flow (LPM)	0.72-0.88		
Photo Pressure (In-Hg-A)	27.0-29.9		
Photo Slope	See Cal. Sheet		
Photo Offset (ppb)	See Cal. Sheet		

Parameter	Range	Reading	Within Range
O3 REF (mv)	3000-4800		
PRES (in-Hg-A)	27.0-29.9		
SAMP FL (cc/m)	720-880		
BOX TEMP (°C)	20-40		
Slope	See Cal. Sheet		
Offset (ppb)	See Cal. Sheet		
Please mark here if a filter is changed			

Setting (ppb)	ANALYZER		TRANSFER STANDARD	Difference[2] (%)
	Stability[1] (ppb)	Indicated (ppb)	Actual (ppb)	
0				N/A
80				
200				

[1]Stability should ≤ 0.3 ppb

[2]Difference (%) = $\frac{Analyzer\ Indicated - Transfer\ Standard\ Actual}{Transfer\ Standard\ Actual} x\, 100\%$

The difference must be within ± 7%. If it is greater than ± 5%, the cause needs to be investigated. Contact the Calibration and Repair Laboratory for assistance.

Information in the last table (Shaded) should be recorded into the electronic log book along with your routine maintenance information (e.g. cleaning the line, changing the filter, etc.).