WASHINGTON STATE DEPARTMENT OF ECOLOGY

Ozone Monitoring Procedure

Air Quality Program

July 2004

95-201G (rev. 7/04)

State of Washington
Department of Ecology
Air Quality Program

OZONE MONITORING PROCEDURE

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July 2004

95-201G (rev 7/04)

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1 INTRODUCTION

This manual is intended for individuals responsible for collecting ambient air monitoring data supported by the Washington State Department of Ecology (Ecology).

The U.S. Environmental Protection Agency (EPA) has determined ground level, or tropospheric, ozone is a health and environmental concern. For this reason, National Ambient Air Quality Standards (NAAQS) have been established for ozone. As a result, an air monitoring network to monitor for ground level ozone in Washington State was established and is maintained by Ecology.

The objective of this manual is to familiarize the station operator with procedures used in the collection of air monitoring data. The accuracy of data obtained from any instrument depends upon the instrument's performance and the operator's skill. It is important that the station operator become familiar with both this manual as well as the manufacturer's instruction manual in order to achieve a high level of data quality.

1.1 Principal of Operation

The analyzers used in the air monitoring network measure the concentration of ozone in ambient air by measuring the absorption of ultraviolet (UV) light in a sample of gas. The measurement is performed using a UV absorption spectrophotometer.

The sample measurement performed in the optics bench (absorptions tubes). A sample is illuminated at one end of the optics bench by a UV lamp and 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 analyzer. The difference between the two cycles is the amount of ozone in the ambient sample.

2 SITE SELECTION

2.1 Monitoring Objectives

Ozone can cover a widespread area when conditions conductive to its formation occur. Therefore, monitoring objectives must first be determined in order to design a strategy that will effectively meet the objective. Examples of monitoring objectives include the following:

- Determine the highest concentrations of ozone expected to occur in the area.
- Determine representative concentrations of ozone in areas of high population density.

- Determine the impact on ambient ozone levels from significant sources.
- Determine general background ozone concentration levels.
- A primary monitoring objective of Ecology is to document the highest ozone concentrations expected in the State. This objective is achieved by determining where the highest concentrations may occur (via special studies and modeling exercises) and establishing a site to monitor for ozone.

2.2 Site Selection for Ozone Monitoring

In selecting a location to measure for ozone, it is important to understand the relationship between ground level ozone, precursors of ozone (i.e. transportation and industrial sources), local meteorology and topography. 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. The worst ozone pollution episodes occur when a slow-moving, high-pressure system develops in the summer and the combination of hydrocarbons, high solar radiation and high air temperatures promote the formation of ozone.

Since ozone levels are significantly lower during the fall and winter months, Ecology is required by the EPA to monitor for ozone only during the "ozone season" (May through September).

For more detailed information concerning site selection for ozone monitoring, refer to the *Quality Assurance Handbook for Air Pollution Measurement Systems*[1], Volume II, Section 2.0.1, entitled "Sampling Network Design and Site Selection", and *Guideline on Ozone Monitoring Site Selection*[2].

2.3 The Monitoring Station

The structure housing the monitoring equipment may consist of a trailer, a room in a building, or a shelter designed specifically for air monitoring purposes. A clean, dry, secure

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[1]To obtain a copy of *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume II, document EPA-600/4-77-027a, (May 1977), contact the EPA, Office of Research and Development, 26 West Martin Luther King Drive, Cincinnati, OH 45268 (phone 513-569-7562).

[2]To obtain a copy of *Guideline on Ozone Monitoring Site Selection* document EPA-454/R-98-002 (August 1998), contact the EPA, Library Services, MD35, Research Triangle Park, NC 27711 (phone 919-541-2777).

and temperature controlled space is required so that the sampling equipment can operate properly.

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 must maintain a temperature range of 68 - 86 degrees F. This usually 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.
- Telephone lines for data transmission to a central computer. A four-wire, dedicated 1200 baud telephone data line is needed to access the Ecology telemetry.
- 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 Public Works Department 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 be offensive to certain people. It is a good idea to have photos or a diagram to explain the proposal.

The majority of Ecology's ozone monitoring stations are small temperature controlled shelters designed specifically for air monitoring purposes. The shelters are placed on a concrete pad and may have a fence constructed around the perimeter of the shelter to provide for security.

2.4 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; and
- The distance of the probe inlet from nearby roads.

These guidelines often dictate the exact location of the air monitoring station. For a summary of these guidelines, refer to Figure 2.1. For new installations in the Ecology air monitoring network, the Ozone Siting Criteria Checklist must be completed once the probe has been installed and the station is operational. The Ozone Siting Criteria Checklist form can be found in the Forms section of this document.

For specific information on monitoring site criteria refer to *Title 40, Code of Federal Regulations, Part 58*[3]*(40 CFR 58)* and Washington State Department of Ecology, Air Quality Program, *Site Selection and Installation Procedures*[4].

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

[4] 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).

Figure 2.1: Probe Inlet Site Criteria Checklist

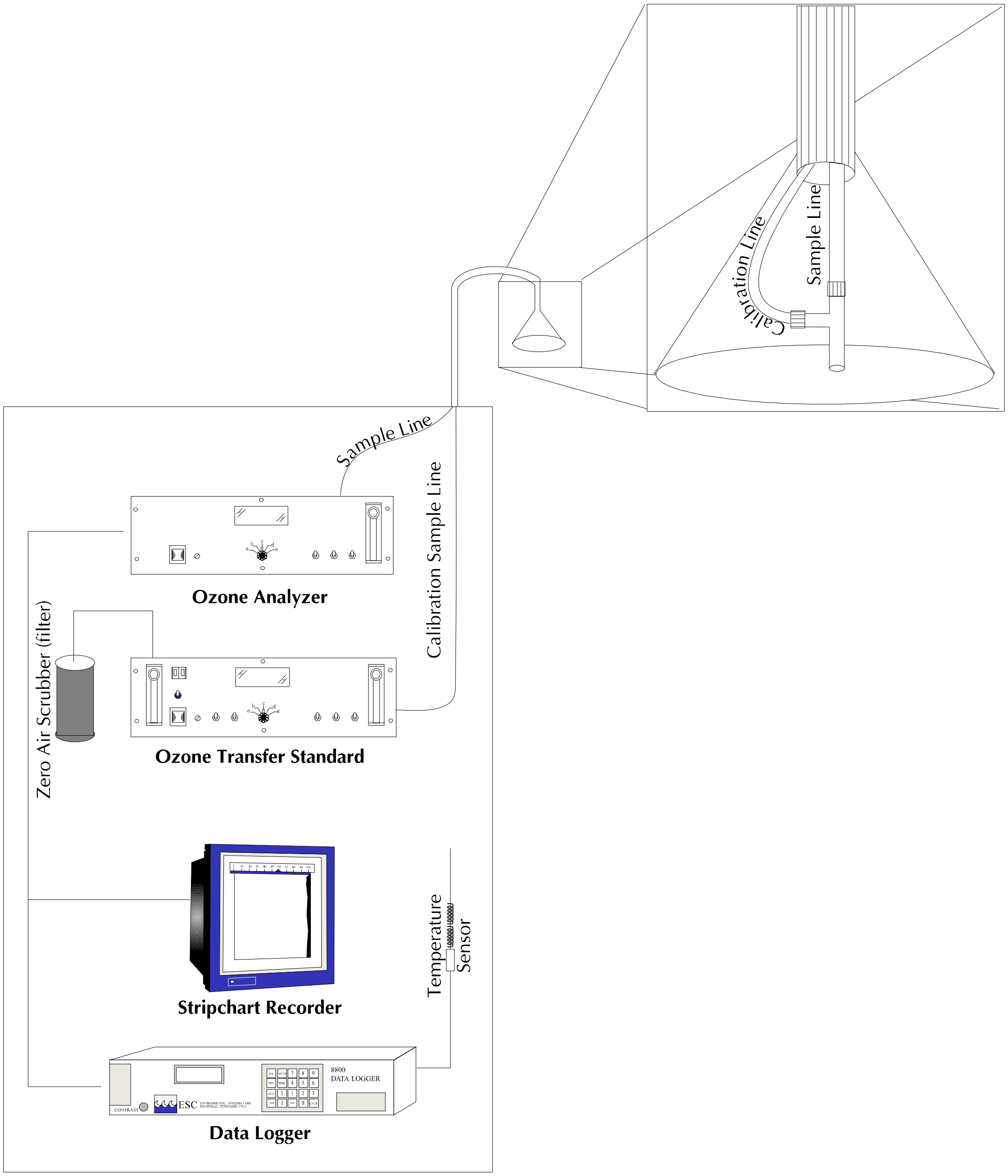
Height Above Ground in Meters	Distance From Supporting Structures in Meters		Airflow Criteria	Distance From Nearest Tree Drip Line	Distance From Nearest Obstacle
	Vertical	Horizontal			
Between 3 and 15	≥ 1	≥ 1	Must have an unrestricted airflow of 270º around the inlet probe, or 180º if located on side of building.	≥20 meters	Must be twice the height of the portion of the obstacle that protrudes above the inlet probe

3 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 3.1). Once the structure to house the equipment is ready; the operator must obtain and install the instruments and supplies that will be required. For the sampling of ozone, all Ecology sites require;

- An ozone analyzer that has been certified by the EPA as an equivalent reference method;
- A combination ozone generator and analyzer (referred to as a "transfer standard") for calibration and precision checks;
- A strip chart recorder;
- A data logger for the storage and transmitting of data;
- Calibration report forms and log books;
- FEP Teflon tubing for sampling lines, ¼ inch (outside diameter);
- A Teflon filter holder for the particulate filter;

Figure 3.1: Ozone Monitoring Station



- 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 data logger to monitor the room temperature;

- The manufacturer's manuals for the instruments;

- Test data, rationale, evidence, and other information indicating 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;
- Spare parts (e.g. a spare UV lamp, 0.5 micron Teflon filters, replacement diaphragms for pumps); and
- Extra chart paper, recorder pens, tape and scissors.

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

4 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 standards must be generated and certified on site.

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

4.1 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.

4.2 Transfer Standards

Transfer standards are used to calibrate the station "field" analyzer and to perform precision and 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. All transfer standards must be accompanied by the following:

- 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;
- Test data, rationale, evidence, and other information indicating 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; and
- 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.
- 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;

4.3 Qualification, Certification and Recertification

Qualification consists of demonstrating that the transfer standard is sufficiently stable (repeatable) to be useful as a transfer standard. Repeatability is necessary over a range of variables such as temperature, line voltage, barometric pressure, elapsed time, operator adjustments, or other conditions, any of which may be encountered during use of the 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:

Equation 1

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

Equation 2

$$I\,(y\ intercept) = \overline{y} - m\overline{x}$$

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

Equation 3

$$\overline{m} = \frac{1}{6}\sum_{i=1}^{6} m_i$$

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

Equation 4

$$\overline{I} = \frac{1}{6}\sum_{i=1}^{6} I_i$$

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

Equation 5

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

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 $\leq 3.7\%$ to maintain certification.

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

Equation 6

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

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:

Equation 7

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

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).

A thorough explanation of ozone analyzers, procedures, and requirements, is contained in *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone*[5].

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. To demonstrate the stability of the instrument, the operator must perform and document routine checks during each station inspection.

5 CALIBRATION

The ozone instruments in Ecology's air monitoring system are calibrated before the start of the ozone monitoring season. The instruments are typically calibrated at the laboratory with generated ozone concentrations of .400 parts per million (ppm), .300 ppm, .200 ppm, .100 ppm and zero air.

Using linear regression, a calibration relationship is determined using the indicated values of the analyzer and the actual values of the transfer standard. The operator records the responses on the

[5] To obtain a copy of *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone*, document EPA 600/4-79-056, contact the EPA, Library Services, MD35, Research Triangle Park, NC 27711 (phone 919-541-2777) or contact the National Technical Information Service (phone 1-800-553-NTIS), document PB86-205465.

Calibration Data Form (Figure 5.1). The calibration data is saved for use as a point of reference for subsequent calibrations.

Figure 5.1: Calibration Data Form

Ecology Calibration Check For Continuous Ozone Analyzers

Site Name ______________________________ **AIRS #**________________ **Date**____________________ **Disabled at:**__________ **PST**
Operator__________________________________ **Enabled at:**___________**PST**

Ozone Tr Standard SN___________ **Correction Factor** _______ **Ozone Analyzer SN**___________
Sample Flow:_______LPM Bar. Pres.___________Atm. Sample Flow:_______LPM Bar. Pres.____________Atm.
Generator Flow:_______LPM Inst Temp.__________C Inst Temp.____________C
Sample Freq:_________KHz Cntrl Freq:__________KHz Sample Freq:________KHz Cntrl Freq:__________KHz

Thumbwheel settings				Analyzer Response		
000	**090**	**400**	**Reading #**	**Point 1**	**Point 2**	**Point 3**
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			
			Average			
			True ozone			
			Difference			

True Ozone = (Average Display) x Factor – Average zero

Difference = <u>Analyzer average – True ozone</u> x 100
True ozone

The difference must be within ± 10%

A thorough explanation of ozone analyzers, procedures, and requirements, is contained in *Technical Assistance Document for the Calibration of Ambient Ozone Monitors*.[6]

6 QUALITY CONTROL

6.1 Station Inspection

Before entering the station, the perimeter should be inspected for damage. Extreme weather conditions, neglect of station 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.

6.2 Station Log Book

A station log book must be maintained at each monitoring site and should accurately reflect site operations. The log book will be identified with the station name, station number, date, time, operator, instrument identification, parameter, scale and units. All entries shall include the date, time, quality control checks, and maintenance on equipment, audits, equipment changes and missing or invalid data. Additional information should include: maintenance performed on the station, abnormal traffic patterns, nearby construction, or sample line cleaning.

Should the data be challenged, the information recorded in the log book is invaluable. A written record of observations concerning abnormal operations or localized occurrences is critical if a violation of ambient air standards were recorded during this period. Completed log books must be sent to Ecology where they will be archived for future reference.

Once the operator has entered the monitoring station, she/he should first:

- Check for any obvious analyzer malfunctions. For example, check to see that the equipment is running, the pumps are operating and the instrument is cycling properly.

- Note any unusual odors or noise. An unusual odor may indicate a point source of a pollutant or a strange new noise can indicate a malfunction in the equipment. These observations should be recorded in the station log book and may prove to be invaluable if the data is challenged.

Once the initial inspection is made, the operator must proceed with a routine inspection and

[6] To obtain a copy of *Technical Assistance Document for the Calibration of Ambient Ozone Monitors*, document EPA 600/4-79-057, contact the EPA, MD35, Research Triangle Park, NC 27711 (phone 919-541-2777) or contact the National Technical Information Service, (phone 1-800-553-NTIS) document PB80-149552.

perform a calibration check on the ozone analyzer.

The station operator is responsible for making several observations during the station inspection. An example of a completed checklist and a step by step guide to aid in completing these duties is given in Appendix A.

6.3 Routine Duties

There are several routine duties that must be performed each time an air monitoring station is inspected. These duties include equipment inspection, performing calibration checks, documentation, and making necessary adjustments or repairs to the instruments.

6.4 Calibration Check

The calibration check is a quality control procedure used to verify that the air monitoring system is operating properly. The check involves 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.

Zero air, ozone concentrations of .100 ppm (the precision) and .400 ppm (the span) are generated by the transfer standard. Each concentration is measured by the transfer standard and the station analyzer. The results are recorded on the Calibration Check form.

Following the zero, precision and span, the deviation from the true ozone value is determined. If the deviation is outside ± 7%, the operator should investigate to see what is causing the error and make the necessary corrections. If the percent difference is outside ± 10%, the cause for the error must be investigated, corrected and the calibration must be repeated. If the results of the calibration check exceed the 10% 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. This procedure is described in Appendix B of this manual, in *40 CFR 58*, Appendix A and *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volumes II and IV.

The calibration check must be performed once every fourteen days and is always performed in the same manner. Failure to perform and document calibration data within the required frequency and concentration may result in the invalidation of data.

6.5 Precision Check

The precision check is included in the calibration check the station operator performs. The operator records the measured response of the transfer standard and the analyzer at the precision level on the Monthly Precision Check Summary form. Figure 6.1 is an example of a completed form. The operator is required to send the form to the Quality Assurance Unit with the strip charts at the end of each month. For more detailed guidance refer to *Automated Method Data Documentation and Validation Procedures*.[7]

[7] To obtain a copy of *Automated Method Data Documentation and Validation Procedures*, contact Washington State Department of Ecology, Air Program/Quality Assurance Unit, P. O. Box 47600, Olympia, WA 98504-7600 (phone 360-407-6837).

Figure 6.1: Completed Monthly Precision Check Summary Form

Monthly Precision Check Summary

AIRS NUMBER: 530010001

PARAMETER: Ozone **YEAR:** 2004 **MONTH:** July

STATE TAG OR ID #: E120444

LOCATION: Mt. Washington **OPERATOR:** Dave Davies

DATE			ACTUAL CONC.	INDICATED CONC.	UNITS	*PASSED? Y or N	COMMENTS
Month	Day	Year					
7	4	2004	.090	.091	ppm	Y	Manual Check
7	12	2004	.089	.090	ppm	Y	Automated Check
7	18	2004	.091	.091	ppm	Y	Manual Check
7	25	2004	.088	.090	ppm	Y	Automated Check

*Shaded area to be completed by QA Personnel

PRECISION CHECK EQUIPMENT:

Gas Cylinder Serial #: __________

Calibrator Model: Dasibi 1008PC

Calibrator Serial #: 5310

Permeation Tube #: __________

Decimal Placement:	
CO	2
SO2	3
NO2	3
O3	3
NEPH	3

COMMENTS:

6.6 Daily Automated Precision Check

The station calibrator is preprogrammed to generate a two- point calibration every morning at 03:00 PST. The calibrator is programmed to generate zero air for fifteen minutes followed by an ozone concentration of 90 ppm for thirty minutes. The calibration is followed by a purge cycle lasting for approximately fifteen minutes. The operator is strongly encouraged to check the daily calibration results from the telemetry each morning to verify that the instrument is operating properly. If there is a difference between the analyzer and the calibrator of ± 10%, the precision results are “flagged”. It is the operator's responsibility to investigate why the calibration check failed.

6.7 Data Acquisition

Data acquisition involves retrieval of the ambient air quality data from the strip chart recorder and the data logger. The station operator has the primary responsibility for distinguishing valid measurements from indications caused by malfunctioning instruments or source interferences. For detailed guidance refer to the *Automated Method Data Documentation and Validation Procedures*.

6.8 Telemetry

The telemetry system can be used by a station operator 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 weekly station visit.

7 Equipment and Maintenance

7.1 The Monitoring Shelter

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.

7.2 Instruments

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 analyzers by the station operator is minimal and is outlined in Appendix A and in the manufacturer's manual. 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.

7.3 Ozone Analyzer

The Ecology air monitoring network uses several models of analyzers all of which have the ability to measure the amount of ozone in a sample. Every analyzer comes with an operating and maintenance manual and must be kept with the analyzer at all times. The information contained in the manual contains instructions concerning:

- installing the analyzer;
- calibrating the analyzer;
- operating the analyzer;
- preventive maintenance schedule and procedures;
- troubleshooting; and
- expendable parts.

The manufacturer's manual is the best resource the station operator has for information on the operation of the ozone analyzer.

Troubleshooting tips can be found in the manufacturer's manual and in Appendix B. It is suggested that each station operator compile personal notes on troubleshooting as they gain experience with the instruments.

If it appears that the field instrument will require major maintenance or repair that will last for several days, the operator must request for a replacement instrument to prevent the loss of data over a long period of time.

7.4 Data Logger

Air monitoring stations operated by Ecology utilize a data logger to acquire process, store and telemeter the air monitoring data to the central computer. No maintenance on the data logger is required but the station operator must contact the Telemetry Specialist in Lacey if a problem occurs.

7.5 Strip Chart Recorder

Strip charts are considered to be the primary record for gaseous pollutant monitors because they provide a graphical record of instrument performance. Ecology uses two main types of recorders in the air monitoring network. The operator should have the appropriate manufacturer's manual for the recorder at the monitoring station and follow the routine maintenance prescribed.

7.6 Sample Intake Line

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.

7.7 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)," each of the operating ozone analyzers will be audited.

8 QUALITY ASSURANCE

8.1 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.

9 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 and certified by Quality Assurance prior to being reported or used to make decisions concerning air quality, air pollution abatement or control.

10 DATA QUALITY ASSESSMENT

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

10.1 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)".

10.2 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.

10.3 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.

11 REFERENCES

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

2) Dasibi Environmental Corporation, *Operating and Maintenance Manual for Model 1008 U.V. Photometric Ozone Analyzer*, Glendale, CA. 1990.

3) Environmental Systems Corporation, *ESC 8800 Data Logger Operation Manual*, Knoxville, TN. 1989.

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

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

6) 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.

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

8) Washington State Department of Ecology, Air Quality Program, *Automated Method Data Documentation and Validation Procedures*, Lacey, WA., Dec. 1993.

APPENDIX A: OPERATING PROCEDURES

New station operators will be provided with on-site training by an experienced operator before they operate a station on their own. The following procedures and checklist are intended to assist the operator in performing and documenting the station inspection.

If a problem is encountered while completing the checklist, refer to the manufacturer's instruction manual or to appendix B of this manual. Assistance is available from Ecology's Air Monitoring Unit. Station operators must become familiar with the Operating and Maintenance Manual for Model 1008 U.V. Photometric Ozone Analyzer[8]

A calibration check is required once every fourteen days, provided that automated checks are done daily. Calibration checks must not be performed during periods of data collection which exceed National Ambient Air Quality Standards (NAAQS) but postponed and performed after the air pollution episode. If the ambient ozone concentrations are exceeding or approaching .080 ppm, the calibration must be postponed.

No instrument adjustments are to be made prior to the calibration check. The purpose of the check is to verify that the air monitoring system is operating properly.

When approaching the monitoring station, make a brief survey of the structure housing the equipment and the condition of the sample probe intake. Look for any damage that may have occurred since the last visit.

Prevent the outside of the shelter from becoming overgrown and unkempt by performing routine maintenance in and around the station.

The majority of the ozone monitoring sites consists of small fiberglass shelters that require a minimum of maintenance. They should be cleaned occasionally with a sponge and soapy water to prevent the buildup of dirt and mildew.

Once in the station, begin the routine inspection. A blank checklist can be found in Appendix C of this document.

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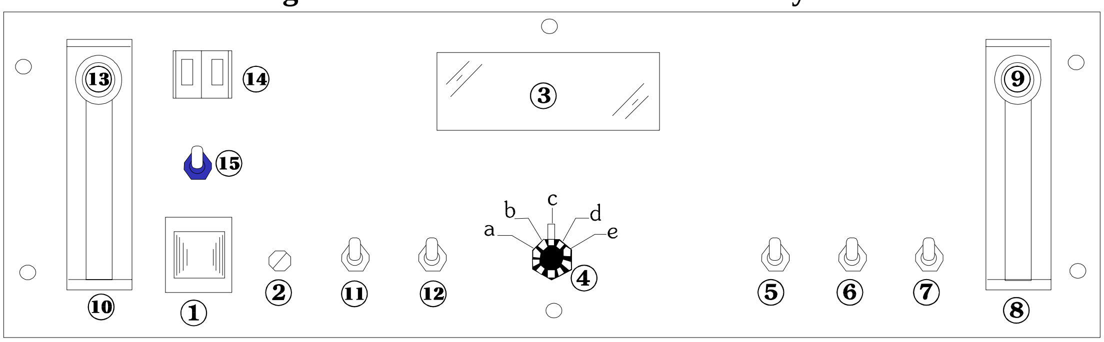
[8] To obtain a copy of *Operating and Maintenance Manual for Model 1008 U.V. Photometric Ozone Analyzer*, contact Ecology's Air Program Technical Services Unit or Dasibi Environmental Corporation, 515 W. Colorado St., Glendale, CA 91204 (phone 818-247-7601).

On the station checklist, record the station name, site number and the name of the person performing the check. Record the time the station was entered (always in Pacific Standard Time), and the date.

Record any damage that has occurred to the station since the last inspection. Note any unusual noises or odors.

Ecology uses the Dasibi 1008 PC ozone analyzer (Figure A-1) to measure the ambient air for ozone concentrations.

Figure A-1: Dasibi 1008PC Ozone Analyzer



Verify that the power is turned ON. The POWER switch should be illuminated and the ozone concentration displayed. If it is not, refer to appendix B of this manual.

The sample flow meter should read at between 1.5 and 3.0 LPM mid ball (try and keep it at 2.0 LPM). If the flow meter drops below 1.5 LPM, refer to appendix B. Always tap the flow meter to make sure the ball has not stuck. Record the results on the Station Checklist.

Verify that the Mode Selector Switch is in the OPERATE mode. Listen for the sound of the solenoid valve energizing and de-energizing to make sure that the solenoid valve is switching. If it is not, refer to appendix B.

Figure A-2: ESC 8816 Data Logger

Ozone concentrations and the station temperature data is transmitted by the data logger (Figure A-2) on designated channels. Ambient ozone data is transmitted on channel 03 and must be disabled before a calibration or maintenance is performed on the analyzer. Once channel 03 is disabled, all transmitted data on channel 03 is "flagged". For detailed guidance on operating the ESC 8800 and Ecology's Telemetry system, refer to the Telemetry Regional Operational Manual.[9]

To obtain instantaneous readings, the operator must press "INS”. The "INS" digital readout on the data logger will display the present ozone concentration on channel 03 with a "D" beside the ozone concentration (ppm). The "D" indicates that channel 03 has been disabled making it possible to perform a calibration without transmitting false ambient readings to the central computers in Lacey and Seattle.

With the MODE SELECTOR Switch set to SAMP/TEMP and the T/P Switch in the ON position, the sampling chamber temperature is displayed in degrees Celsius. This number should be between 30 and 40 degrees Celsius. If it is not, refer appendix B. Record the results on the Station Checklist.

Switch the T/P Switch to the OFF position. The sample frequency is displayed. The display value is updated every 1.5 seconds and corresponds to one ten thousandth of the actual frequency. To determine the frequency in KHz, move the decimal point one place to the right (i.e. a reading of 42.301 would be 423.01 KHz). The optimum frequency reading should be between 450-480 KHz. Record the results on the Station Checklist.

Set the MODE SELECTOR Switch to CONT/PRES. With the T/P Switch in the ON position,

[9] To obtain a copy of the *Telemetry Regional Operational Manual*, contact Ecology, Air Program, Telemetry Specialist, P. O. Box 47600, Olympia, WA 98504-7600 (phone 360-407-6834).

the sample chamber pressure is displayed in atmospheres. A barometer is used to check if this reading is correct and by following Section 6.5.8 of the manufacture's manual. Record the results on the Station Checklist.

Set the T/P Switch to the OFF position and observe the control frequency of 500 KHz. This is a fixed control frequency and cannot be adjusted by the operator. Record the results on the Station Checklist.

Set the MODE SELECTOR Switch back to OPERATE and the T/P Switch to ON.

Place the MODE SELECTOR Switch to ZERO and observe the front panel DISPLAY, chart recorder and the data logger. When the digital display is reading zero, the recorder and data logger should indicate .000 V. Record the results on the Station Checklist.

If the recorder or data logger is not reading zero, refer to appendix B or Section 6.6.4 in the Operating and Maintenance Manual for Model 1008 U.V. Photometric Ozone Analyzer. Help can also be obtained by calling Ecology's Air Monitoring Unit.

Place the MODE SELECTOR Switch to SPAN and read the values on the display. The recorder should exceed the scale of the chart.

Observe the display. The first three numbers represent the span setting and the last two numbers represent the zero offset. Dasibi recommends that the span number be set to 308 (this adjustment is made inside the instrument). Read Section 6.6.2 of Operating and Maintenance Manual for Model 1008 U.V. Photometric Ozone Analyzer for more details.

Turn the MODE SELECTOR Switch back to OPERATE.

The Dasibi 1008 PC is used as the ozone transfer standard. The transfer standard/calibrator contains an ozone generator and an analyzer housed within a shared chassis.

Figure A-3: Dasibi 1008 PC Ozone Generator/Analyzer

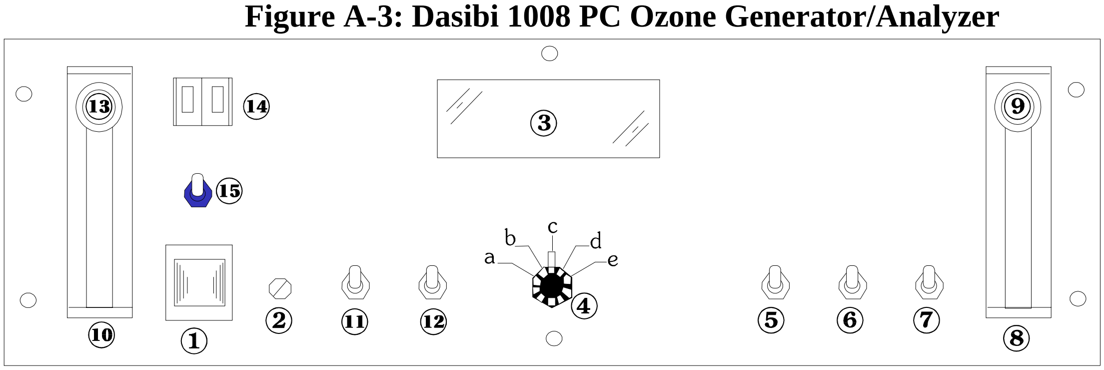


Table A-4: Dasibi 1008 PC Front Panel Key

1. Power Switch	2. Analog Span Pot	3. Display
4. Mode Selector Switch	5. T/P Switch	6. Valve Switch
7. Sample Pump Switch	8. Sample Flowmeter	9. Sample Flow Adjust
10. Generator Flow Adjust	11. Ozone Lamp Switch	

Set the OZONE ADJUST thumbwheels (14) to 000. These three thumbwheels give the user control of the ozone generator's concentration.

Set the AUTO/MAN Switch (15) in the AUTO mode. In the AUTO mode, the ozone generator is put into feedback with the photometer. The user simply selects the desired ozone concentration using the OZONE ADJUST thumbwheels and the selected ozone concentration is supplied to the analyzer.

Set the OZONE Switch (11) to OFF. This switch is used for turning ON the ozone generating lamp.

Set the PUMP Switch (12) to ON. This switch is used for turning the ozone generator pump ON or OFF.

Set the MODE SELECTOR Switch (4) to the OPERATE position. This switch is used for selecting the different instrument operating modes.

Set the T/P Switch (5) to ON. In the operate mode, ozone readings are automatically corrected for temperature and pressure changes.

Set the VALVE Switch (6) to ON. This switch is used for controlling the analyzer gas valve

Set the PUMP Switch (7) to ON. This switch is used for turning the photometer pump ON or OFF.

Turn the Transfer Standard ON (1) and allow the unit to warm up and stabilize. Allow thirty minutes for the instrument to warm up.

The front panel switches which control the analyzer in the Dasibi 1008 PC are similar to the Dasibi 1008 AH. Repeat the instrument checks made on the Dasibi 1008 AH in steps 6.2.3 through 6.2.6 on the Dasibi 1008 PC and record the results.

THE CALIBRATION CHECK

Connect the sample lines as illustrated in Figure A-5. A tee in the sample probe prevents over pressurizing the Dasibi 1008 PC by venting excess sample gas during a calibration check (this is illustrated in Figure 3.1). If the station has the "dual" line configuration, cap one of the ozone outputs on the Dasibi 1008 PC.

If the station is not equipped with a calibration sample line connected to a tee, connect a short length of quarter inch FEP Teflon tubing from an ozone output port and vent to the outside.

When performing a calibration check, use the calibration worksheet provided in Appendix D. Follow the procedures listed below.

1 Write the site name, site number, date, station operator on the calibration data sheet.

2 Record the analyzer state number.

3 Record the transfer standard state number.

4 Record the Sample Frequency and the Span Dial Setting.

5 Verify the switches on the transfer standard are in the following positions.

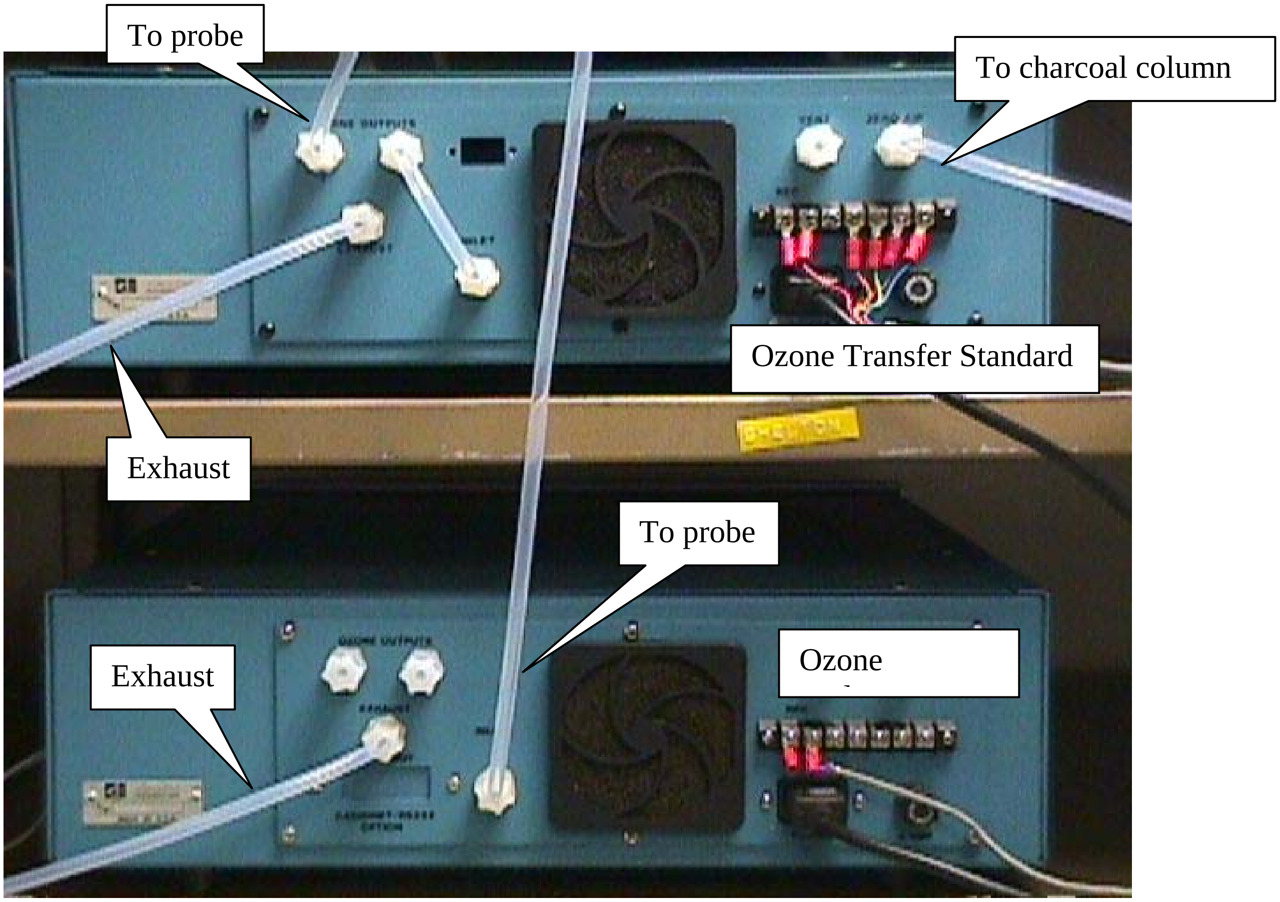


Figure A-5: Calibration Configuration

- Set the T/P Switch to ON.
- Set the VALVE Switch to ON.
- Set the PUMP Switch to ON.
- Set the GENERATOR Switch to ON.
- Set the UV Lamp Switch set to OFF.
- Adjust the thumbwheels to 000.

6 A pump in the Dasibi 1008 PC draws in ambient air purified by an external activated carbon column. Ecology requires an activated carbon column in all the air monitoring stations. This charcoal column (or "scrubber") will sufficiently cleanse the air of contaminants likely to cause a detectable response on the analyzer.

7 The "zero air" is regulated by the generator flow meter (10) before it enters into a manifold located in the Dasibi 1008 PC. The ozone analyzers share a manifold with a short length of quarter inch FEP Teflon tubing.

8 Both instruments draw zero air from the manifold located in the Dasibi 1008 PC. If both instruments sample flow meters are adjusted to 2.0 LPM, the instruments will "pull" 4.0

LPM of sample air from the manifold.

9 While sampling zero air, allow the Dasibi 1008 PC sufficient time to warm-up (at least half an hour). This warm-up period allows the transfer standard to stabilize. The covers of both instruments should be on during the calibration, as the calibration is dependent upon the internal temperature of the analyzer. After a few minutes the OZONE CONCENTRATION display on both instruments should display readings near 0.000 ± .005 ppm. If not, corrections must be made following the calibration check.

10 Make no adjustments until after completing the calibration. There must be an excess of at least l.0 LPM of air than the sum of the sample flows of both instruments. If the two instruments are pulling 4.0 LPM of air from the manifold, the generator flowmeter adjust (13) on the Dasibi 1008 PC should be adjusted to 5.0 LPM. This additional 1.0 LPM of sample air must be vented to the atmosphere to prevent over pressurizing the Dasibi 1008 PC. The tee in the sample probe allows for this.

11 With the zero air flowing, verify that the transfer standard Display (3) reads .000 ppm ± .005 ppm. Average concentrations are determined by using a "ten count ". Ten readings of the instruments response are taken over a period of ten to fifteen minutes and recorded.

12 While the analyzer and transfer standard are sampling zero air, record 10 consecutive digital display values ("10 counts") in the respective columns labeled "zero". The ozone concentration display on both the analyzer and transfer standard is updated every 10 seconds and is indicated by the flashing red light on the OZONE CONCENTRATION display (3). Give the analyzer and the transfer standard adequate time to update when recording each of the values.

13 Ecology uses the ESC 8816 data logger for data recording. The values indicated on the data logger are the values that are being transmitted to, and recorded by the central computer. Therefore, it is important that the data logger, analyzer display and the strip chart recorder all read the same value. Discrepancies must be investigated, corrected and recorded following the calibration check.

14 Read the ten analyzer ppm concentration values from the data logger and the transfer standard at the same time and record them on the data sheet. After ten readings have been taken, calculate the average of the ten readings from the data logger and the transfer standard and record the average on the calibration check sheet.

15 Set the OZONE ADJUST thumbwheels (14) to 100 to produce an ozone concentration of approximately .100 ppm. Set the AUTO/MAN Switch (15) in the AUTO mode and turn the

OZONE Lamp Switch (11) ON. Allow the instruments time to measure the concentration by waiting several minutes until a stable reading is achieved (this usually takes about 15 minutes depending on the condition of the particulate filter). Wait until the pen trace on the strip chart recorder plateaus before taking the readings.

16 Perform a ten count and record the instruments' response. Calculate the average of the ten readings from the data logger and the transfer standard and record the averages on the calibration data sheet. Round the result ending in 5 to the even number, i.e. .0985 to .098 and .0995 to .100. This way, half of the results get rounded up and half rounded down.

17 Over time, the operator will become familiar with the time it takes for the pen to plateau. If this period of time begins to take abnormally long, it is an indicator that the particulate filter in the sample line is dirty and needs replacing.

18 Adjust the OZONE ADJUST thumbwheels (14) to 400 to produce an ozone concentration of approximately .400 ppm. Allow the instrument time to measure the concentration then perform a ten count. Record the ten consecutive digital display values on the calibration data sheet. Calculate the average of the ten readings and record the values on the calibration check sheet.

19 Calculate the summation of averages for the analyzer (Y) by adding the averages for the three points checked and write this value in the space provided on the Calibration Check Form.

20 Calculate the true ozone value using the equations on the Ecology Calibration Check form and record this value in the space provided on the form.

Using the following equation to determine the percent difference between the analyzer and the transfer standard:

Equation 8

$$\frac{Analyzer\ Averages(Y) - Transfer\ Standard\ Averages(X)}{Transfer\ Standard\ Averages(X)} x\,100\% = \_\_\_\_\_\ \%$$

21 If the percent difference is outside ±10% or if the zero reading is greater than .005ppm, the calibration must be repeated, the cause for the error must be investigated and corrected. If the results of the calibration check exceed the limits, the data recovered since the previous calibration check is subject to invalidation. Once the problem has been identified and corrected, a calibration check must be performed to demonstrate that the system is operating properly.

FOLLOWING A CALIBRATION CHECK

Sample Flowmeter Adjustment

Adjust the sample flow meter (9) to 2.0 LPM. The flow should not be less than 1.5 LPM nor greater than 3.5 LPM. Record the adjusted value on the Weekly Station Checklist. If the flow should drop below 1.5 LPM, it should be noted on the strip chart. Ambient ozone data is subject to invalidation is flow drops below 1.5 LPM.

Sample Frequency Adjustment

The sample frequency will decrease as dirt and dust particles collect throughout the optical path, as the UV lamp output decays, or as the efficiency of the detector diminishes. If the adjusting procedures fail to restore the frequency to adequate levels, contact the Ecology's Air Monitoring Unit. Cleaning of the optics or replacement of the UV lamp may be necessary (this procedure is detailed in the manufacturer's manual). To adjust the proper frequency, remove the cover from the instrument and locate thumbscrews located on the UV source block (Figure A-6). The manufacturer's manual contains several good diagrams which will help the operator locate the source block.

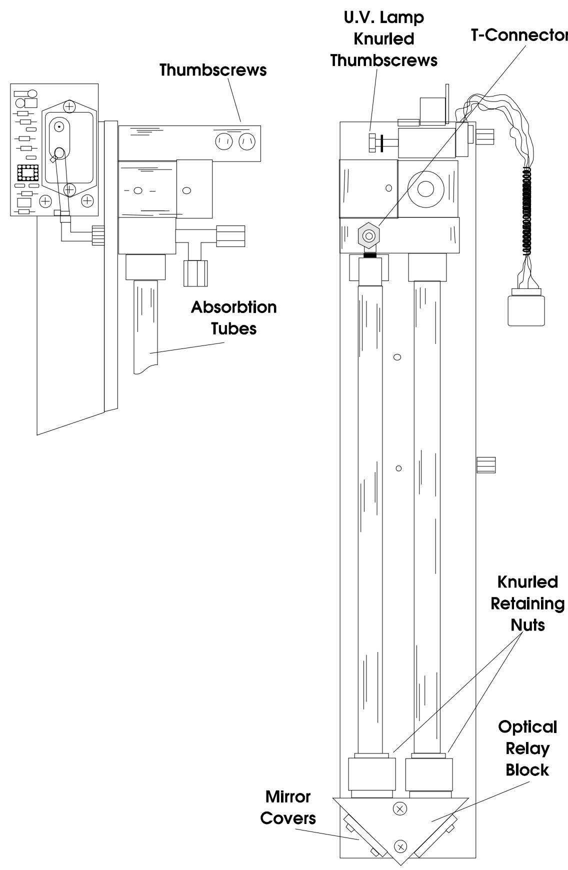


Figure A-6: Thumbscrew Location

CAUTION !! There is high voltage within portions of the circuitry of this analyzer. Please refer to the Dasibi manual before performing any servicing inside the unit.

CAUTION !! Ultra Violet light can cause burns of the cornea. Use glasses to view the lamp or look at it for only a couple of seconds at a minimum distance of 0.5 meters.

The thumbscrews which hold the UV lamp in place should be loosened and the lamp pulled out of the housing to decrease the frequency, or pushed into the housing to increase the frequency. The lamp may be rotated to change the frequency. It takes very small movements of the lamp to make large frequency changes. The thumbscrews should be tightened to take a frequency reading.

System Leak Check

To perform a system leak check on the analyzer, remove the sample line from the SAMPLE INLET on the back panel. The front panel controls should be set as follows;

- MODE Switch set to CONT/PRESS.
- T/P Switch set to ON.
- Analyzer PUMP Switch set to ON.
- VALVE Switch set to ON.
- Analyzer flow meter set to 2.0 LPM.

Plug the SAMPLE INLET (a finger may be used). The flow, as indicated on the flow meter, should drop to zero. If it does not, there is a leak in the system. The source of the leak must be determined and corrected.

Solenoid Leak Check

To perform a solenoid valve leak check, remove the sample line from the SAMPLE INLET on the back panel. Remove the ozone scrubber, and locate the Kynar elbow on the solenoid valve. This is the ZERO AIR INLET. The front panel controls should be set as follows;

- MODE switch set to CONT/PRESS.
- T/P Switch set to ON.
- Analyzer PUMP switch set to ON.
- VALVE Switch set to OFF.
- Analyzer flow meter set to 2.0 LPM.

Plug the ZERO AIR INLET (a finger may be used). The flow, as indicated on the flow meter, should drop to zero. If it does not, there is a leak in the system. If no leaks were found, reconnect all in-cabinet plumbing and perform a system leak check.

Particulate Filter Changes

A 0.5 micron Teflon filter housed in a Teflon filter holder is located on the outside of the analyzer (refer to Figure A-5) and is connected to the sample line. The filter should be changed every two weeks or when noticeably dirty. Slow response of the analyzer during the calibration check is an indication of a dirty filter or contaminants in the sample line. To replace the used filter, loosen the four screws connecting the two halves of the filter holder and replace the dirty filter with a new filter.

Realign the filter gasket, reconnect the two halves of the filter holder and tighten the four screws. Do not over tighten as this may damage the filter gasket.

Following a filter change, perform a high span for at least half an hour. This is to "condition" the new filter and serves as a check to see if there any leaks in the reassembled filter holder.

Cleaning the Sample Lines

It is the operator's responsibility to maintain the sample lines. A routine cleaning of the sample lines is required if the operator suspects a loss in ozone concentrations due to contamination in the line. Sample lines must be either replaced or thoroughly cleaned prior to sampling at the beginning of the Ozone season.

To clean the sample lines, disconnect the sample line from the analyzer and the calibration sample line from the calibrator. Inject the lines with water and a soapy solution and flush the solution through the lines using a small pump or air compressor. Small balls of cotton can also be blown through the line to scrub the lines but must be done with care to avoid plugging the line. Following the flushing, the operator must thoroughly dry the sample lines before reconnecting it to the instruments. This is done by blowing air through the lines for several minutes.

Once the sample lines have dried, reconnect the sample lines and perform a high span to condition the line and to check that the system is operating properly.

STRIPCHART RECORDER

Check the time the pen is indicating on the stripchart recorder (Figure A-7). The time on the stripchart recorder should match the time on the data logger. If the difference is greater than 10 minutes, a note should be made on the stripchart. Correct the time on the stripchart by advancing the chart roll to the correct time. The chart roll should never be rolled back.

Check to make sure the ink pen is drawing a good trace. The ink in the chart pens usually last for several months.

Check that there is an adequate supply of chart paper in the recorder to last until the next scheduled station visit.

The operator should determine if an adequate supply of expendable parts are at the station (chart paper, pens, fuses, etc). These items can be ordered from the Air Monitoring Unit.

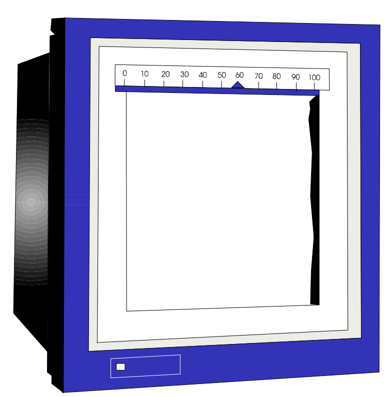


Figure A-7: Stripchart Recorder

The operator should write down the time the station was secured. This is helpful in determining the amount of time the operator spends at the site which could be used for the supervisor or for estimating operational costs.

Write down any maintenance that was performed on the instrument or additional comments that may effect the air monitoring system. Examples include:

- replacement of UV lamps, pumps or tubing;
- repairs or maintenance made to or around the shelter;
- abnormal localized occurrences nearby;
- suggestions for improvements to the system;
- supplies that are needed; or
- audits that were performed.

Before leaving the station, make sure the shelter or room is secured.

APPENDIX B: TROUBLE ISOLATION

The instruments in Ecology's air monitoring network are very reliable. However, after a period of continuous use problems may occur. Leaks in the system, dirt build up and U.V. lamp failure are typical. After time, the operator should be able to quickly distinguish the symptoms and causes of equipment failure.

This section is intended to assist the operator in locating analyzer malfunctions when they occur. Listed below are common problems that the operator might experience and the possible cause. Possible solutions are included but should not be attempted by individuals who are unfamiliar with the instruments.

The numbers in the Problem section of the following chart correspond to the steps in the Station Checklist. Sections referenced in the table under Corrective Action reference the Dasibi Model 1008 Series Operating and Maintenance Manual.

DANGER!! ELECTRICAL SHOCK HAZARD. There is HIGH VOLTAGE within portions of the circuitry of this analyzer. Please refer to material within the Dasibi manual before performing any servicing inside the unit.

It is suggested that each station operator consult the Dasibi Instruction Manual and compile personal notes on troubleshooting as they gain experience with the Dasibi instruments. The operator is encouraged to contact the Air Monitoring Unit when attempting any repairs.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Analyzer is on but lamp is not lit.	**Lamp bulb is blown**	**Replace the lamp bulb.**
Analyzer is not operating	**Blown fuse**	**Replace the blown fuse.**
	Power cord is loose or disconnected	**Reinsert power cord.**
Analyzer operating without digital display	**200 VDC Power Supply inoperative**	**Contact the Air Monitoring Unit. The problem may be in the voltage or in the plug in display.**
Zero ozone output when monitoring ambient air.	**Pump stopped**	**Check the power to the pump or change the pump if necessary.**
Low sample flow	**Flowmeter may be adjusted wrong**	**Adjust the flowmeter to the correct setting.**
	Dirty sample line filter	**Replace the filter.**
	Leak in the system	**Refer to Section 6.5.9 of Manual.**
Recorder trace erratic when analyzer is sampling	**Loose absorption tubes**	**Tighten the absorption tube checking the O-rings for proper seal. Refer to Section 6.7**
Recorder trace periodically goes to zero and remains there for a period of time, and then returns to ambient ozone reading.	**Solenoid not switching**	**Contact the Air Monitoring Unit. The problem may be in the solenoid driver card or the solenoid may be defective.**
Excessive temperature drift	**Temperature sensor may be out of adjustment.**	**Adjust the trimpot on the Temperature Circuit Board. Refer to Section 6.5.7.**
Low sample control frequency readings.	**U.V. lamp out of adjustment**	**Adjust the U.V. lamp. Refer to Section 3.4.2.2.1**
	Dirty optics	**Clean the optics. Refer to Section 6.7.**
Loss of the sample control frequency.	**Faulty detector**	**Replace the electrometer assemble. Contact the Air Monitoring Unit.**
Unstable sample control frequency.	**Loose lamp or detector**	**Tighten the set screws holding the lamp and detectors.**

Low barometric pressure	**Dirty sample line filter** **Pressure span pot out of adjustment**	**Replace the sample line filter.** **Refer to Section 6.6.7.**
Does not read 500 KHz		**Contact the Air Monitoring Unit.**
Chart zero not in agreement with digital display (display 00.00).	**Digital to Analog (D-A) converter zero not properly adjusted.**	**Adjust the chart zero with the zero pot on the D-A board. Analog span pot on the front of the analyzer until the recorder is in agreement with the display. Refer to Section 6.6.3.**
Chart span not in agreement with digital display.	**Analog span pot improperly adjusted.**	**Adjust the analog span pot on the front of the analyzer until recorder is in agreement with the display. Refer to Section 6.6.3.**
Calibration check out of limits.	**Sample lines dirty or have moisture accumulation.**	**Clean the sample lines.**
	Teflon particulate filter dirty.	**Replace the filter.**
	Leak in the sample line.	**Replace the sample line.**

APPENDIX C: BLANK FORMS

The following blank forms are to be copied by the operator and used for the station inspection. Additional copies can be obtained by calling Ecology, Air Programs, Quality Assurance, 1-360-407-6837.

OZONE (O_3)

Siting Criteria Checklist

Site Name: ______________________________ Site #: | | | | | | | | | |

Address: ________________________________

City: ____________ County: ______________

---

1. Vertical distance from ground to probe: ____ Meters
   Must be between 3 and 15 meters. NOTE: The inlet probe must be located away from dirty, dusty areas.

2. Distance from support structure? ____ Meters
   Distance both horizontally and vertically should be ≥ 1 meter.

3. Is there an unrestricted air flow in an arc of 270º (180º if on the side of a building) and is the predominant wind direction included in the arc? ____ Yes ____ No

4. Distance from probe to drip line of nearest tree(s)? ____ Meters
   The distance between probe and nearest tree dripline should be ≥ 20 meters. If the tree acts as an obstruction, it must be ≥ 10 meters to drip line.

5. Distance from the inlet probe to the nearest obstacle? ____ Meters
   The distance must be at least twice the height of the portion of the obstacle that protrudes above the inlet probe.

6. Comments: ____

____

____

Completed by: ______________________________

Agency: ______________________________

Monthly Precision Check Summary

AIRS NUMBER: ____________________

PARAMETER: ________________________ **YEAR:** __________ **MONTH:** __________

STATE TAG OR ID #: ____________________

LOCATION: ________________________ **OPERATOR:** ________________________

DATE			ACTUAL CONC.	INDICATED CONC.	UNITS	*PASSED? Y or N	COMMENTS
Month	Day	Year					

*Shaded area to be completed by QA Personnel

PRECISION CHECK EQUIPMENT:

Gas Cylinder Serial #: ____________________

Calibrator Model: ____________________

Calibrator Serial #: ____________________

Permeation Tube #: ____________________

Decimal Placement:	
CO	2
SO2	3
NO2	3
O3	3
NEPH	3

COMMENTS:

WASHINGTON DEPARTMENT OF ECOLOGY
MONTHLY QUALITY CONTROL MAINTENANCE CHECK FORM

LOCATION:______________________________ **STATION NUMBER:**___________________________________

MONTH/YEAR:___________________________ **STATION OPERATOR:**_________________________________

DATE	ANALYZER RESPONSE				TRANSFER STANDARD RESPONSE				RESULTS: % Diff
	SAMPLE FLOW	ZERO	PRECISION	SPAN	SAMPLE FLOW	ZERO	PRECISION	SPAN	

OPERATOR DUTIES:

1) WEEKLY CHECKS: AIRFLOW, CHART TRACE. ELECTRONIC ZERO , SPAN AND CORRESPONDING CHART READINGS; SAMPLE AND CONTROL FREQUENCIES. LEAK TEST AIRFLOW SYSTEM.

2) MONTHLY CHECK; LEAK CHECK SOLENOID VALVE. DATE TESTED:

3) DATE O.5 MICRON TEFLON FILTER WAS REPLACED:______________ **SAMPLE LINE CLEANED ON:**

STATION CHECKLIST	
Site name	
Site number	
Operator	
Record the time the station was entered.	PST
Record the date the station inspection.	
THE MONITORING STATION	
2.Has any damaged occurred to the station since the last inspection?	
Are there any unusual noises or odors?	
THE ANALYZER	
Is the power on?	
Is the sample flow set to 2.0 LPM?	
Is the selector switch in the "operate" mode?	
Is the solenoid valve cycling every 10 seconds?	
Has channel 03 on the data logger been disabled?	
Has it been noted on the strip chart?	
Record the sample chamber temperature.	^{o}C
Record the unadjusted sample frequency.	KHz
Record the sample chamber pressure.	Atm
Is the control frequency 50.000?.	
Do the analyzer, recorder and data logger all read the same?	
Record the analyzer span setting.	
THE TRANSFER STANDARD	
Is the ozone adjust thumbwheels set to 000?	
Is the auto/man switch in the "auto" position?	
Is the ozone switch in the "off" position?	
Is the generator pump switch in the "on" position?	
Is the selector switch in the "operate" position?	
Is the T/P switch in the "on" position?	
Is the valve switch in the "on" position?	
Is the sample pump switch in the "on" position?	

How long was the transfer standard allowed to warm up? Allow it to warm up for at least ½ hour.	Minutes
Is the ozone generator flowmeter set to 5 LPM?	
Is the sample flowmeter set to 2.0 LPM?	
Record the unadjusted sample frequency.	KHz
Is the control frequency 50.000?	
Was a calibration check performed ?	
Were the results from the calibration within the limits?	
FOLLOWING A CALIBRATION	
Were any adjustments made to the analyzer?	
Were any adjustments made to the transfer standard?	
Was a leak check performed on the analyzer?	
Was a leak check performed on the transfer standard?	
Has the sample filter been checked?	
When was filter last replaced?	
Has the transfer standard been turned off?	
Is the transfer standard ozone pump switched to OFF?	
Is the ozone lamp switched to OFF?	
T/P switch to ON, Valve switch to ON, Pump switch to OFF?	
Is the thumbwheel on the ozone lamp set to 090?	
Has channel 03 on the data logger been enabled?	
STRIPCHART RECORDER	
Does the time on the stripchart recorder read the same as the data logger time?	
If it does not, what is the difference between the two?	Minutes
Does the recorder pen need to be replaced?	
Does the chart paper need to be changed?	
Are any station supplies needed?	
Record the time the monitoring station was left.	PST
ADDITIONAL COMMENTS OR MAINTENANCE	