STATE OF CALIFORNIA

AIR RESOURCES BOARD

QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX AC

ENVIRONICS 9100 GAS CALIBRATOR

MONITORING AND LABORATORY DIVISION

NOVEMBER 1997

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STATION OPERATOR'S PROCEDURES FOR THE ENVIRONICS 9100 GAS CALIBRATOR

MONITORING AND LABORATORY DIVISION

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AC.1.0 GENERAL INFORMATION

AC.1.0.1 SYSTEM DESCRIPTION

Federal regulations require a minimum of two precision points per month for each criteria pollutant analyzer to validate the ambient air quality data. The model 9100 Environics gas calibration system is designed for the unattended calibration of ambient air samplers/analyzers on a daily basis. Calibration systems, operating at ARB air monitoring sites, will perform this calibration at 03:50 Pacific Standard Time (PST). As presently configured, the nightly calibration lasts 1 hour and 12 minutes. This allows the sample inlet probe and ambient air analyzers enough time to equilibrate/stabilize, perform 4 calibration points, and only lose one hour of valid ambient air quality data per day. The system is capable of providing ambient level concentrations of pollutant gases by precise dilutions with zero air, and high concentrations of pollutants in a compressed gas cylinder carbon monoxide (CO), nitrogen oxide (NO), sulfur dioxide (SO2), and methane (CH4) in ultra high purity nitrogen.

AC.1.0.2 PHYSICAL DESCRIPTION

The Environics Series 9100 ambient air monitoring calibration system is a single unit module, with an advanced micro-processor which manages the operation of mass flow controllers, for dynamic calibration of ambient air analyzers on a daily basis. Refer to page 4 of the Environics 9100 Manual for an illustration of the System Flow Diagram. Refer to page 6 of the Environics 9100 Manual for an illustration of the front view of the calibrator. This appendix has been developed to supplement the manufacturer's instruction manual for installing, operating, and calibrating the Environics 9100.

The Environics 9100 is equipped with two mass flow controllers. The air mass flow controller has a range of 0-20 standard liter per minute (SLPM), and is operated at 13.0 SLPM for the daily precision and span checks. The gas mass flow controller operates through the 0 to 100 standard cubic centimeter per minute (SCCM) flow range. It controls gas flow at 82 SCCM for the daily span checks, and at 22 SCCM for the weekly precision checks. The basic principle of operation in the mass flow controller uses the property of thermal conductivity. The mass flow of the gas is referenced to 760 millimeters mercury (mmHg) and 25 degrees centigrade. Therefore, standard temperature and pressure corrections are automatically performed by the instrument to maintain accurate flows in any operating environment.

The Environics 9100 also contains an ozone generator. Ozone can be generated by entering the desired concentration through the 9100 keypad. Ultraviolet (UV) light at a wavelength of 184.9 nanometers produces ozone in dry air inside the ozone generator. The ozone concentration is controlled by the voltage applied to the UV lamp. This calibrator is capable of the gas phase titration of nitric oxide (NO) with ozone (O3) to produce nitrogen dioxide (NO2).

AC.1.0.3 PROGRAMMING THE TIMER CONTROL

The Environics will be programmed with the information contained in Table AC.1.0.1. The Environics 9100 gas calibration system used in ARB air quality monitoring sites is programmed to perform five "precision" level calibrations, and two "span" level calibrations during the seven (7) day per week cycle. To review the present weekly program, or to enter a new program, PRESS **Program Mode** from the Main Menu. Then PRESS **Timer Control**. Next PRESS **Recall**. The Environics 9100 display should look like the following:

Register	**Name**
01	**Weekly**
02	
03	
.	
.	
.	

Recall SETUP in Register 01

PRESS **ACCEPT**. To start the calibrator PRESS **START**. If successful, the Environics will display the following typical message:

Wednesday 05 October 94	**Waiting for Thursday 03:50**

Table AC.1.0.1
Timer Control Display

	Sun.	Mon.	Tue.	Wed.	Thur.	Fri.	Sat.
Sequence	2 PRECI	2 PRECI	2 PRECI	2 PRECI	2 PRECI	1 SPAN	1 SPAN
Start	03:50	03:50	03:50	03:50	03:50	03:50	03:50
Duration	01:12	01:12	01:12	01:12	01:12	01:12	01:12
Stop	05:02	05:02	05:02	05:02	05:02	05:02	05:02

Wednesday 05 October 94 Waiting for Thursday 03:50

AC.1.0.4 PROGRAMMING DAILY SPAN AND PRECISION SEQUENCE

The Environics gas calibration system will be programmed with the information contained in Table AC.1.0.2. The calibration will be performed in the "Flow" mode. To enter this information from the Main Menu PRESS **Program Mode**. Then PRESS **Sequence**. Next PRESS **Recall**. The Environics 9100 display should look like the following:

Register	**Name**
01	**Span**
02	**Precision**
03	
.	
.	
.	

Recall SETUP in Register 01

PRESS **ACCEPT** to the appropriate choice (01 or 02). Use the arrow key to move around the screen. The code for NO is the number 2. PRESS **SAVE** when the screen is complete.

Table AC.1.0.2
Sequence Control Display

Sequence Control
01 Span

Item	Run Time	Mode	Port	Air	Gas	Air Total	Ozone	Gas ID	Conc.
1	18	Flow	2	13.0	0.0	13.0	0.0	NO	0.0
2	18	Flow	2	13.0	82.0	13.082	0.0	NO	0.742
3	18	Flow	2	13.0	82.0	13.082	0.5	NO	0.742
4	18	Flow	2	13.0	0.0	13.0	0.5	NO	0.0

Sequence Control
02 Span

Item	Run Time	Mode	Port	Air	Gas	Air Total	Ozone	Gas ID	Conc.
1	18	Flow	2	13.0	0.0	13.0	0.0	NO	0.0
2	18	Flow	2	13.0	22.0	13.022	0.0	NO	0.188
3	18	Flow	2	13.0	22.0	13.022	0.09	NO	0.188
4	18	Flow	2	13.0	0.0	13.0	0.09	NO	0.0

AC.1.0.5 PROGRAMMING OUTPUT STATUS FOR DATALOGGER

The Environics gas calibration system will be programmed with the information contained in the following table. To enter this information, from the Main Menu PRESS **SETUP, OUTPUT**. The Environics 9100 display should look like Table AC.1.0.3 below:

Table AC.1.0.3

DATALOGGER OUTPUT DISPLAY

CONDITIONS/ STATUS	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	**JUST**	**M1**	**P1**				
2	**JUST**	**M1**	**M2**	**P1**	**P2**		
3	**JUST**	**M1**	**M2**	**P1**	**P2**	**OZ**	
4	**JUST**	**M1**	**P1**	**OZ**			
5	**ANY**	**S01**					
6	**ANY**	**M1**					
7	**ANY**	**M1**					

PRESS exit when done.

AC.1.0.6 PROGRAMMING MAINTAIN PORTS

The Environics gas calibration system can be programmed with gas concentrations such as those found in the following table to allow the 9100 to operate in the Concentration Mode. To enter this information, from the Main Menu PRESS **MAINTAIN PORTS**. The Environics 9100 display should look like Table AC.1.0.4 below:

Table AC.1.0.4

MAINTAIN PORTS DISPLAY

Cylinder Gas Concentration		Gas ID
BALANCE		
108.0	PPM	NO
5400.0	PPM	CO
54.0	PPM	SO2
2160.0	PPM	CH4
0.0	PPM	

If Nitric Oxide is in this mix, "NO" MUST be used for the Gas ID.

Cylinder Identification: CC12488

Port >2

PPM OR % CYL ID PRT SCRN EXIT

PRESS exit when done.

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ENVIRONICS 9100 GAS CALIBRATOR

MONITORING AND LABORATORY DIVISION

NOVEMBER 1997

AC.2.0 INSTALLATION PROCEDURE

AC.2.0.1 PHYSICAL INSPECTION

Unpack the instrument and check that all the required parts have been received in good condition. Open the instrument cabinet to determine if there are any loose PC boards, tubing, filters, or electrical connections. Mount the unit in the 19-inch rack. Plug in the unit and turn on the power. The 9100 should power up to the Main Menu. Set the timer to +/- 2 minutes Pacific Standard Time (PST) if needed.

AC.2.0.2 DATALOGGER CONNECTION

The ESC datalogger will scan the analog output voltage of the air quality analyzers. When the Environics 9100 is in the calibrate mode, the data will be flagged as calibration data. An interface cable must be installed to identify the type of data. The Environics 9100 is connected to a model 8800 ESC datalogger with a six-wire connector. The following list indicates the present sequence of leads at the terminal labeled “STATUS OUTPUT” at the rear of the Environics 9100:

9100 Terminal #	Wire Color
1+	White
1-	Black
2+	Blue
2-	Green & Black Jumper
3+	Red
3-	Black Jumper & Black Jumper
4+	Orange
4-	Black Jumper

The following list indicates the present sequence of terminals and wires at the rear of the ESC datalogger. These connections are on the bottom row of inputs labeled “Digital In 1-8":

8800 Terminal #	Wire Color
GND	Black
1	White
2	Blue
GND (2)	Green
3	Red
4	Orange

AC.2.0.3 MANIFOLD CONNECTION

Connect the Environics 9100 Calibrator to an appropriate gas cylinder, Aadco pure air supply, and station manifold as illustrated in Figure AC.2.0.1.

Connect the output of the Environics gas calibration system to 1/4 inch outer diameter (OD), FEP Teflon tubing. The tubing will be connected to the inlet of the air monitoring station's sample probe line. For stations equipped with sample probes made from ½ inch inner diameter (ID) teflon line with a braided stainless steel covering a glass "candy cane" is available, with a 1/4 inch ID glass inlet at the apex of the bottom glass arch. Connections from the station manifold to the analyzers can be made with 5/16 inch OD Teflon tubing and Jaco elbow fittings. A one-inch section of 5/16 inch OD Teflon tubing will be slippped over 1/4 inch OD FEP Teflon tubing. The 1/4 inch OD tubing will connect the sample inlet manifold to the ambient air analyzers.

Details for connecting ambient air analyzers to a monitoring station glass manifold as described in Section 2 (Figure 2.0.1.1.2) of the Quality Assurance Manual, Volume II.

AC.2.0.4 AADCO CONNECTION

Connect the output of a Model 737 Aadco pure air supply to Port 1 of the Environics 9100 with 1/4 inch OD, FEP Teflon tubing. The output pressure of the Aadco should be set at 35 psig. The electrical starting signal for the Aadco air purifier comes from terminals 6 and 7 of the "STATUS OUTPUT" in the rear of the Environics 9100.

AC.2.0.5 SUPERBLEND CONNECTION

Use a double stage, stainless steel regulator with a CGA 660 connector. The regulator output pressure should be set at 20 psi. The tubing between the superblend cylinder and the Environics gas calibration system shall be cleaned, 1/8 inch OD, stainless steel tubing. All connections shall be made with Parker-Hannifin, Swagelock or equivalent stainless steel, compression fittings.

AC.2.0.6 CAUTIONS

The inside of the calibrator contains open 110 volt conductor paths.

The ultraviolet (UV) lamp utilizes high voltage. Use normal high voltage precautions when working on this calibration system. Do not work on the calibrator with the power on unless the test absolutely requires it, and then only after you have removed your watch, rings, etc.

Always use static discharge equipment when handling circuit boards.

The ozone generator contains a UV lamp. UV light can cause damage to the cornea of the eye. Use UV safety glasses if working with the UV lamp.

Use the proper precautions with high pressure compressed gases (superblend). For further compressed gas safety information refer to the Air Quality Surveillance Branch Safety Plan.

The superblend gas mixture contains high concentrations of poisonous gases.

Do not pressurize the input greater than 40 psi.

Record you password.

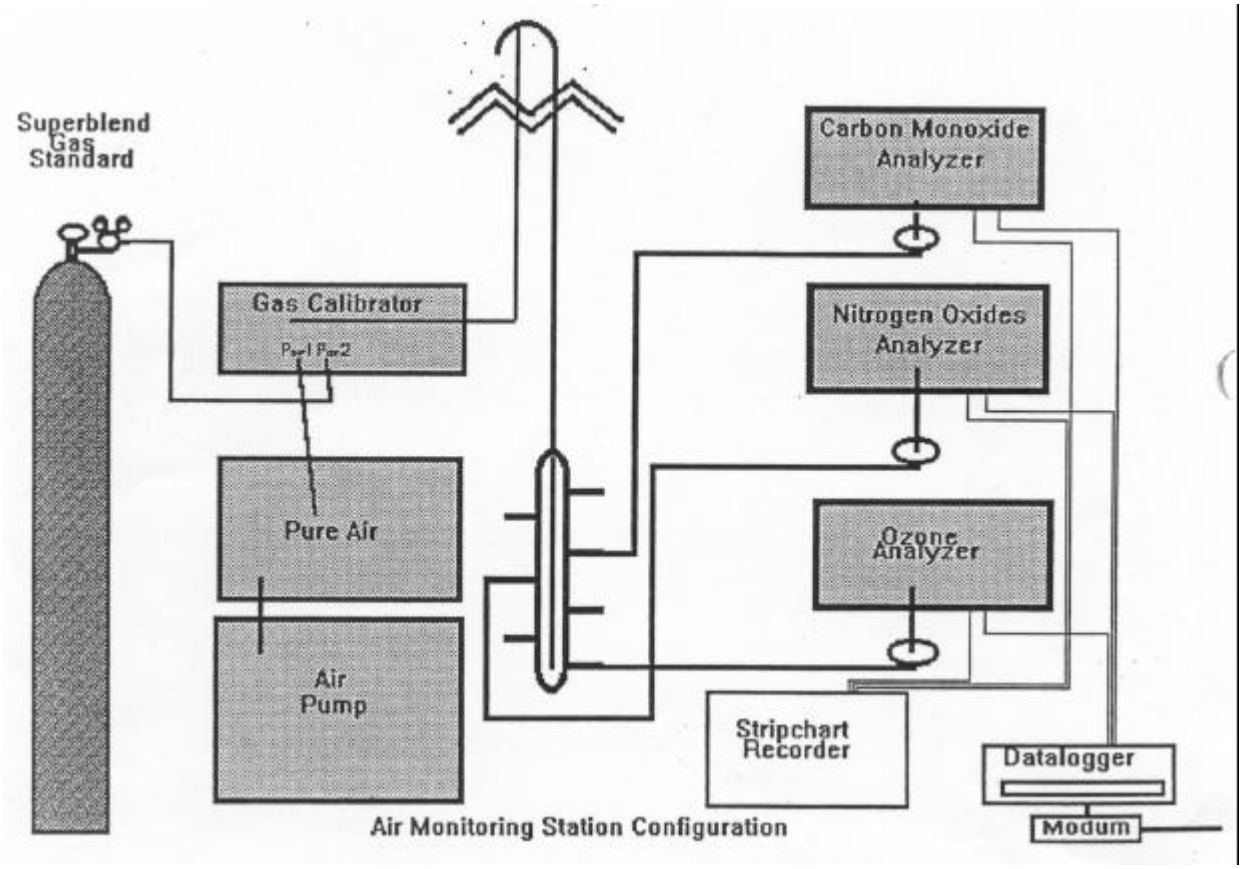

Figure AC.2.0.1
Manifold Connection Setup

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APPENDIX AC.3

ENVIRONICS 9100 GAS CALIBRATOR
ROUTINE SERVICE CHECKS

MONITORING AND LABORATORY DIVISION

NOVEMBER 1997

AC.3.0 ROUTINE SERVICE CHECKS

AC.3.0.1 GENERAL INFORMATION

Perform the following checks and maintenance at the intervals specified in Table AC.3.0.1. Perform non-routine maintenance as required to assure accurate and complete data recovery. Checks may be performed more frequently but should be performed at least at the prescribed intervals. The Monthly Quality Control Maintenance Checksheet (Figure AC.3.0.1) should be completed weekly and forwarded monthly with the stripcharts to the person that performs the second level of data review.

AC.3.0.2 DAILY CHECKS

1. Verify that the power is on.
2. Check the instrument display. It should be in the TIMER CONTROL mode with the typical message at the bottom of the screen reading:

Wednesday 05 October 94 Waiting for Thursday 03:50

3. Ensure that the time and date are correct on this display.
4. Review the strip chart recorder(s) for the calibrations performed earlier in the day. Ensure that all the instruments have zero readings within +/- one-half of a chart division, and ensure that the daily precision or span values are within +/- 10 percent of the previous calibration value.

AC.3.0.3 WEEKLY CHECKS

Observe and record the zero and span values, for all of the appropriate pollutants, on the monthly checksheet MLD-115.

AC.3.0.4 MONTHLY CHECKS

1. Check and record superblend output pressure, cylinder pressure, and certification expiration date.

2. Check the ozone block temperature, the ozone lamp drive voltage, and the ozone generator pressure.

These parameters can be measured from the FLOW MODE. To get there press the following key pad selections in the order presented below:

STOP, EXIT, EXIT, FLOW MODE, START. Record the parameters. To return to the Weekly Timer Control press the following key pad strokes in the order presented below: **STOP, EXIT, PROGRAM MODE, TIMER CONTROL, RECALL, WEEKLY, 01 ACCEPT, START.**

3. Verify the cooling fan is operating.

4. Inspect tubing and power cord for loose connections, kinks, cracks, or other defects. Repair and replace as necessary.

AC.3.0.5 SEMI-ANNUAL CHECKS

1. System leak check
2. Ozone output calibration
3. Gas flow calibration
4. Air flow calibration

AC.3.0.6 ANNUAL CHECKS

Vacuum the inside of the unit to remove accumulated dust.

AC.3.0.7 30-MONTH CHECKS

Replace the 7 micron filter. Be sure to document the replacement date with a Dymo label or equivalent.

Table AC.3.0.1
Environics 9100 Gas Calibration System
Routine Service Checklist

	Day	Week	Month	SemiAnnual	Annual	30-Month
Power On	X					
Timer Control Display	X					
Time/Date	X					
Observe Zeroes and Spans	X					
Record Zeroes and Spans		X				
Superblend Output Pressure			X			
Superblend Tank Pressure			X			
Ozone Block Temp			X			
Ozone Lamp Voltage			X			
Ozone Generator Pressure			X			
Observe Fan Operating			X			
Observe Tubing and Fittings			X			
Observe Electrical Cords			X			
Leak Check				X		
Ozone Calibration				X		
Flow Calibration				X		
Vacuum Unit					X	
Replace 7 Micron Filter						X

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY MAINTENANCE CHECK SHEET
FOR THE
ENVIRONICS 9100 GAS CALIBRATION SYSTEM

LOCATION: _____ MONTH/YEAR: _____
STATION NUMBER: _____ TECHNICIAN: _____
SAMPLER PROPERTY NUMBER: _____ AGENCY: _____

OPERATOR INSTRUCTIONS:

1. Each Day: Check Power, Display, Date/Time, Observe Zeroes and Spans.
2. Weekly Interval: Record Zeroes and Spans.

Date		O3	NOX	NO	NO2	CO	CH4	THC	SO2
	z								
	s								
	z								
	s								
	z								
	s								
	z								
	s								
	z								
	s								

3. Monthly Interval: Superblend Output Pressure _____, Superblend Tank Pressure _____, Observe Fan, Tubing, Fittings, and Wires; Ozone Lamp Voltage _____.
4. Semi-Annual: Leak Tests; Date _____, Ozone Calibration; Date _____, Flow Calibrations; Date _____.
5. Annual: Vacuum inside of unit; Date _____, Replace Superblend; Date _____.
6. 30-Month Interval: Replace 7 Micron Filter; Date _____.

Date	Comments or Maintenance Performed:

Reviewed By: _____ Date: _____

MLD-115 (02/96)

Figure AC.3.0.1
Monthly Quality Control Maintenance Checksheet

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ENVIRONICS 9100 GAS CALIBRATOR

CALIBRATION PROCEDURE

MONITORING AND LABORATORY DIVISION

NOVEMBER 1997

AC.4.0 CALIBRATION PROCEDURE

AC.4.0.1 THEORY

The Environics 9100 mass flow controllers (MFCs) and ozone generator shall be calibrated on a semi-annual basis. The Environics 9100 MFCs are calibrated by flow comparisons with a National Institute of Standards and Technology (NIST) traceable flow transfer standard certified by the MLD's Standards Laboratory. The ozone generator is calibrated by comparing the Environic's 9100 output to that of a NIST traceable ozone transfer standard.

AC.4.0.2 APPARATUS

Certified ozone transfer standard

Set of certified 4-in-1 mass flow meters

Laptop computer and printer

Printer paper, ink cartridges, cables

5/16 inch diameter Teflon Dowel rod

2-4 TRBZ-SS compression fitting

Teflon tubing

Wrenches

Two 2-inch pieces of 5/16 inch OD tubing, 1/4 inch ID

NIST Traceable Pressure and Temperature Standard

AC.4.0.3 LEAK TEST

The leak test is described in Section 5.14 in the Environics Manual (page 27). Before starting this procedure:

1. Disconnect the "Digital In" connection from the rear of the datalogger;

2. Disconnect the output of the Environics 9100 calibrator to the station inlet probe; and

3. To decrease the Aadco air pressure, exit the **TIMER CONTROL**. This is accomplished by pressing **STOP, EXIT, EXIT**. Go into the **FLOW MODE**. Command 13 1pm for MFC 1. PRESS **START**. The Aadco air purifier will turn on. After the Aadco has had a minute to come up to full pressure, note the pressure. It should be about 35 psig. Decrease the diluent air pressure (from the Aadco) to between 5 and 10 psig. (This is equivalent to a absolute pressure of between 20 and 25 psig.) PRESS **STOP** then **EXIT** to return to the Main Menu.

4. To perform the leak test, PRESS **MORE** from the Main Menu to display the second page of the Main Menu. The Leak Test option is on the second page of the Main Menu. PRESS **LEAK TEST**, and **START**. The system will automatically perform the leak test. A leak rate of less than 5 SCCM is acceptable. Record the result on the laptop calibration sheet. If the leak test is greater than 5 SCCM, troubleshoot the unit following the manufacturer's instructions.

   After the leak test, reset the output pressure of the diluent air to 35 psig, or the original pressure set point.

AC.4.0.4 AIR FLOW CALIBRATION

As Is Air Flow Calibration

1. Plug in the flow transfer standard, and turn on the power switch. It should warm up for at least one hour.

2. Turn off the station superblend gas regulator.

3. Ensure the "digital in" connector is unplugged in the back of the datalogger. If not removed, the Environics 9100 Calibrator will mark all the criteria pollutant data with "C"'s in the datalogger.

4. Disconnect the 1/4 inch OD Teflon tubing from the Environics 9100 output to the station inlet probe. Plug the inlet probe line with a 1/4 inch OD Swagelock type cap. Connect the 1/4 inch OD Teflon line from the Environics 9100 output to a 0-30 SLPM certified flow transfer standard.

5. Fill in the pertinent data on the laptop calibration spreadsheet labeled AS-IS MFC (Table AC.4.0.1)

6. Perform an "As Is" calibration as described below. Sections 5.7.1 and 5.7.2 in the Environics 9100 Manual cover flow calibrations (pages 16-19)

   In the Main Menu, Press **FLOW MODE**.

7. Set the MFC 2 (gas) "Target" to **0.00** SCCM, and set the Ozone "Target" to **0.00** ppm.

8. Operate the Environics 9100 20 SLPM MFC at 5 flow points. These will be 15, 14, 13, 12, and 11 SLPM.

9. Set the MFC 1 (air) "Target" to 15 SLPM. With the cursor at the 15 SLPM cell, PRESS **START**. The Aadco pure air generator should turn on as source of air for the flow calibration. Make sure that the Aadco's output is set to 35 psig.

10. After 5 minutes, record the calibrator's "Actual Flow" reading, the transfer standard display reading, and calculate the true flow from the transfer standard's certification equation on the calibration data sheet.

11. Enter the "Target Flow" of **14** SLPM and PRESS **UPDATE**. Wait 2 minutes and record flows. Repeat this procedure for "Target Flows" of **13**, **12**, and **11** SLPM. After all of the flow data has been collected, PRESS **STOP**.

    If the MFC operates at greater than 13,500 SCCM or less than 12,500 SCCM at 13 SLPM, then a "Final" calibration is necessary.

Table AC.4.0.1
MFC Calibration Report

ARB Calibration Report – Environics Gas Calibration System

MFC Calibration:

Flow Transfer Standard I.D.:

	Tylan 4-1
Prop. #:	20003865
Cert. Date:	10/15/96
Cert. Exp.:	01/14/97

Calibration:

Cal. Type:	As is
Calibration Date:	10/21/96
Previous Cal. Date:	5/20/96

Flow Transfer Standard Equation:		m:	x :		b :	
0-30 MFC:	Air Flow =	0.9752	*Avg. Display	+/-	-0.2025	SLPM
0-100 cc MFC:	Gas Flow =	0.9947	*Avg. Display	+/-	-0.6973	SLPM

Air Flow Calibration Data – 0-30 slpm MFC:

Manual Flow Setpt:	15.0	14.0	13.0	12.0	11.0
Envir. Output Flow (Display):	14.97	13.99	13.00	12.01	10.72
Transfer Std. (Display):	15.64	14.67	13.67	12.67	11.32
True Air Flow (slpm):	15.05	14.10	13.13	12.15	10.84
Net change (Setpt. - T.F.):	-0.05	-0.10	-0.13	-0.15	0.16

Note: +/- 0.5 Lpm tolerance.

Gas Flow Calibration Data – 0-100 sccm MFC:

Manual Flow Setpt:	92.0	82.0	72.0	62.0	52.0	42.0	32.0	22.0	12.0
Envir. Output Flow (Display):	91.990	82.000	72.020	62.000	52.030	42.000	32.010	22.010	[illegible]
Transfer Standard:	91.46	81.75	71.73	61.81	52.12	42.22	32.28	22.20	[illegible]
True Air Flow (sccm):	90.28	80.62	70.65	60.79	51.15	41.30	31.41	21.39	[illegible]
Net change (Setpt. - T.F.):	1.72	1.38	1.35	1.21	0.85	0.70	0.59	0.61	0.54

Note: +/- 2cc tolerance

Air Flow Cal. – 0-30 sccm MFC:

Manual Flow Setpoint: (x)	True Air Flow: (y)	Line Calc.
15.0	15.05	15.13
14.0	14.10	14.09
13.0	13.13	13.05
12.0	12.15	12.02
11.0	10.84	10.98

Air Flow Linear Regres. Equ.:

TAF (Slope):	1.0376
Setpt. (Intercept):	-0.4346

MFC Air Linear Regression Output:

Constant		-0.43460
Std Err of Y Est		0.13030
R Squared		0.99529
No. of Observations		5
Degrees of Freedom		3
Correlation	0.99764	
X Coefficient(s)	1.0376	
Std Err of Coef.	0.041	

MFC Regression

Gas Flow Cal.– 0-100 sccm MFC:

Manual Flow Setpoint: (x)	True Air Flow: (y)	Line Calc.
92.0	90.2780	90.40
82.0	80.6194	80.55
72.0	70.6525	70.70
62.0	60.7851	60.85
52.0	51.1465	51.00
42.0	41.2989	41.15
32.0	31.4116	31.31
22.0	21.3850	21.46
12.0	11.4579	11.61

MFC Gas Linear Regression Output:

Constant		-0.21189
Std Err of Y Est		0.12334
R Squared		0.99998
No. of Observations		9
Degrees of Freedom		7
Correlation	0.99999	
X Coefficient(s)	0.9849	
Std Err of Coef.	0.002	

MFC Regression

Gas Flow Linear Regres. Equ.:

TAF (Slope):	0.9849
Setpt. (Intercept):	-0.2119

Comments:			
Calibrated by:	LMJ	[illegible]	Checked by:

ARB Calibration Report – Environics Gas Calibration System

Calibration Report:

ID Information:

Station Name:	South Lake Tahoe
Site #:	09-691
Station Address:	Sandy Way
Agency:	ARB

Instrument:

Make:	Environics
Model #:	9100
Elect. Chassis #:	20002612
Log #:	N/A

Calibration:

"As Is"	
"Final"	X
Calibration Date:	10/21/96
Prev. Calib. Date:	5/20/96

Air & Gas Flow (MFC) Calibration Summary:

Manual Flow Setting:	True Air Flow (sccm):	True Gas Flow (sccm):
13,000	13,128	
82.0		80.62
22.0		21.39

Meteorology:

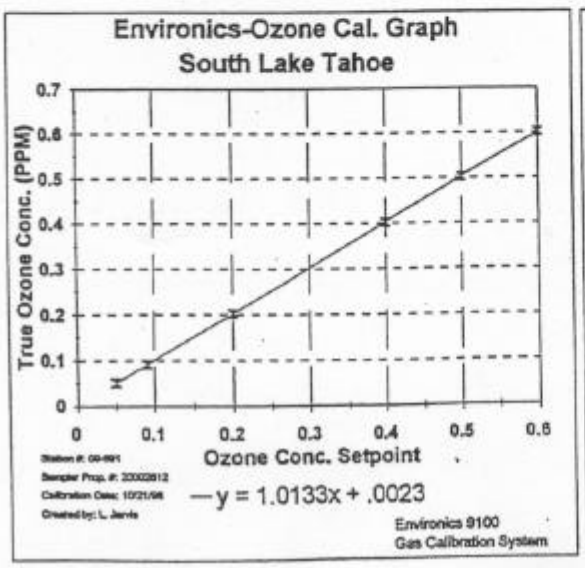
Temp. (Deg. C):	22.4
Atm. Pres. (mm Hg):	618.1
Elevation (Ft.):	6250
ACF:	1.25970

Expected Concentrations:

Pollutant:	Span Conc. (ppm):	Precision Conc. (ppm):
CO	33.0	8.8
CH4		
NO	0.699	0.186
SO2		
O3 & NO2	0.504	0.091

Superblend Cylinder:

Cert. Tag #:	CC12406
Output Pres. (psig):	20.0
Cyl. Pres. (psig):	1290
CO Conc. (ppm):	5405
CH4 Conc. (ppm):	2156
NO Conc. (ppm):	114.6
NOx Conc. (ppm):	114.6
SO2 Conc. (ppm):	52.2



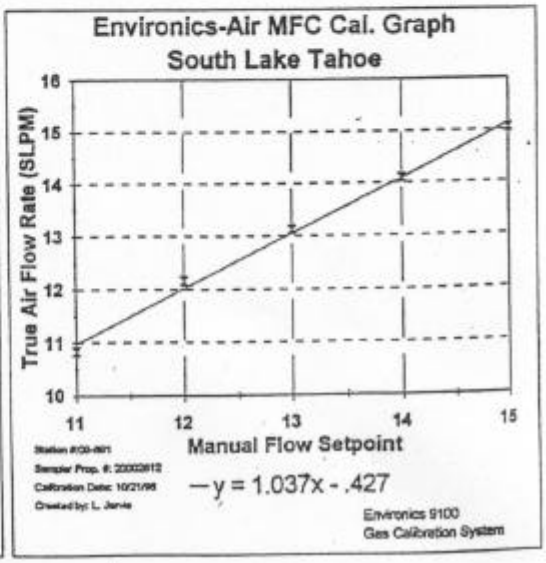


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Figure AC.4.0.1
Flow Calibration Report

Table AC.4.0.2
"As Is" Calibration Tolerances

Item	Parameter	Tolerances
0-100 SCCM MFC	True Gas Flow Rate	+/- 2 SCCM @ 22 SCCM +/- 2 SCCM @ 82 SCCM
0-20 SCCM MFC	True Air Flow Rate	+/- 500 @ 13,000 SCCM
Ozone Generator	Ozone Output	+/- .005 ppm @ .09 ppm +/- .050 ppm @ .50 ppm
Leak Test	System Integrity	- 5 SCCM @ 25 PSIA (10 psig)

AC.4.0.5 FINAL AIR FLOW CALIBRATION

1. If the true flow is not within +/- 500 SCCM of the 13,000 SCCM command flow, then the mass flow controller will need a "Final" calibration.

2. From the Main Menu PRESS **CALIBRATE MODE**.

3. Enter the password **XXXX**. (If displayed)

4. The display should read:

   The system is using a single slope and intercept for computing flows.
   03 adjusted - pressure gauge is on
   Stop Flow On

   PRESS **FLOW REVISE**.

5. At MFC 01, PRESS **ACCEPT**. At Port 1 PRESS **ACCEPT**.

   There are 11 data cells in the "Command Column", and there are 5 points collected from the As Is calibration. Therefore, enter **15** SLPM in twice, **14** SLPM in twice, **13** SLPM in thrice, **12** SLPM in twice, and **11** SLPM in twice in the "Command Flow" column.

6. Enter the flow values generated by the certified flow transfer standard in the "True Flow" column for the corresponding 15, 14, 13, 12 and 11 SLPM "Command Flows".

7. Record the previous slope and intercept before recalculating a new slope and intercept. PRESS **CALC**, and PRESS **YES** to question: Do you want a new slope and intercept? PRESS **SAVE CALC DATA**. PRESS **YES** to the question: "Do you really want to?"

8. Record the new slope and intercept generated by this calibration.

9. To exit from this test and return to the MAIN MENU, PRESS **STOP**, **EXIT**(s).

10. Run a confirming 5 point calibration by repeating AC.4.0.4.1 from Step 7.

AC.4.0.6 AS IS GAS FLOW CALIBRATION

1. Disconnect the pure air supply from Port 1, and cap the end of the inlet filter (Port 1) with a 1/4 inch Swagelock type plug.

2. Note the delivery pressure of the superblend gas regulator. Turn off the gas cylinder at the cylinder valve. Disconnect the 1/8 inch OD stainless steel super blend tubing at the back of the 9100.

3. With a 2-4 TRBZ-SS compression fitting connect the Aadco or some other pure air supply to Port 2. Connect the output of the Environics 9100 to a 0-100 SCCM certified flow transfer standard.

4. From the Main Menu, PRESS **FLOW MODE**.

5. Set the MFC 1 "Target" (air) to **0.0** SLPM, and set the Ozone "Target" to 0.00 ppm.

6. Set the MFC 2 "Target" (gas) flow to 92 SCCM. Enter **92** SCCM in for the flow rate of the gas, PRESS **START**. The Aadco air supply will not turn on when Port 2 is energized. Therefore, the Aadco must be started manually. Set the output pressure to 20 psig or the superblend delivery pressure.

7. After 5 minutes, record the "Actual Flow", the transfer standard display reading, and calculate and record the true flow from the transfer standard's certification equation and the transfer standard reading.

8. Enter **82** SCCM in for the flow rate of the gas, PRESS **UPDATE**.

9. After 2 minutes, record the "Actual Flow", the transfer standard display reading, and calculate the true flow from the transfer standard's certification equation and the transfer standard reading.

10. Repeat this procedure for the "Target Flows" of **72**, **62**, **52, 42, 32, 22,** and **12** SCCM.

11. To exit from this test and return to the MAIN MENU, PRESS **STOP**, **EXIT**(s).

12. If a final calibration is not required, make sure the Aadco output pressure is set back to 35 psig, the stainless steel line is replaced, and the superblend cylinder is turned on ready to operate.

AC.4.0.7 FINAL GAS FLOW CALIBRATION

1. If the true gas flow at the 82 SCCM set point is not within +/- 2.0 SCCM of the target flow rate, or if the true gas flow at the 22 SCCM set point is not within +/- 2.0 SCCM of the target flow rate, then the gas mass flow controller will need to have a final calibration.

   From the Main Menu PRESS **CALIBRATE MODE**.

2. Enter the password **XXXX**.

3. The display should read:

   The system is using a single slope and intercept for computing flows.
   03 adjusted - pressure gauge is on
   Stop Flow Off

4. Press **MFC FLOW,**

5. At MFC 02, PRESS **ACCEPT**. At Port 2 PRESS **ACCEPT**.

6. If the flows measured in the As-Is calibration were greater than 2 SCCM away from true at 82, or 2 SCCM away from true at 22 SCCM, then a new set of numbers must be entered into the Environics gas calibration screen. This is done by operating the unit at 92, 82, 72, 62, 52, 42, 32, 22, and 12 SCCM. The values from these 9 data cells are entered in the "Command Column" and the FINAL MFC laptop spreadsheet.

7. Enter the values generated by the certified flow transfer standard in the "True Flow" column for the corresponding 92, 82, 72, 62, 52, 42, 32, 22, and 12 SCCM "Command Flows".

8. Record the previous slope and intercept before recalculating a new slope and intercept. PRESS **CALC**, and PRESS **YES** to question: Do you want a new slope and intercept? PRESS **SAVE CALC DATA**. PRESS **YES** to the question: "Do you really want to?"

9. Record the new slope and intercept generated by this calibration.

10. To exit from this test and return to the MAIN MENU, PRESS **STOP**, **EXIT**(s).

11. Run a confirming 5 point calibration by repeating AC.4.0.6 from Step 4.

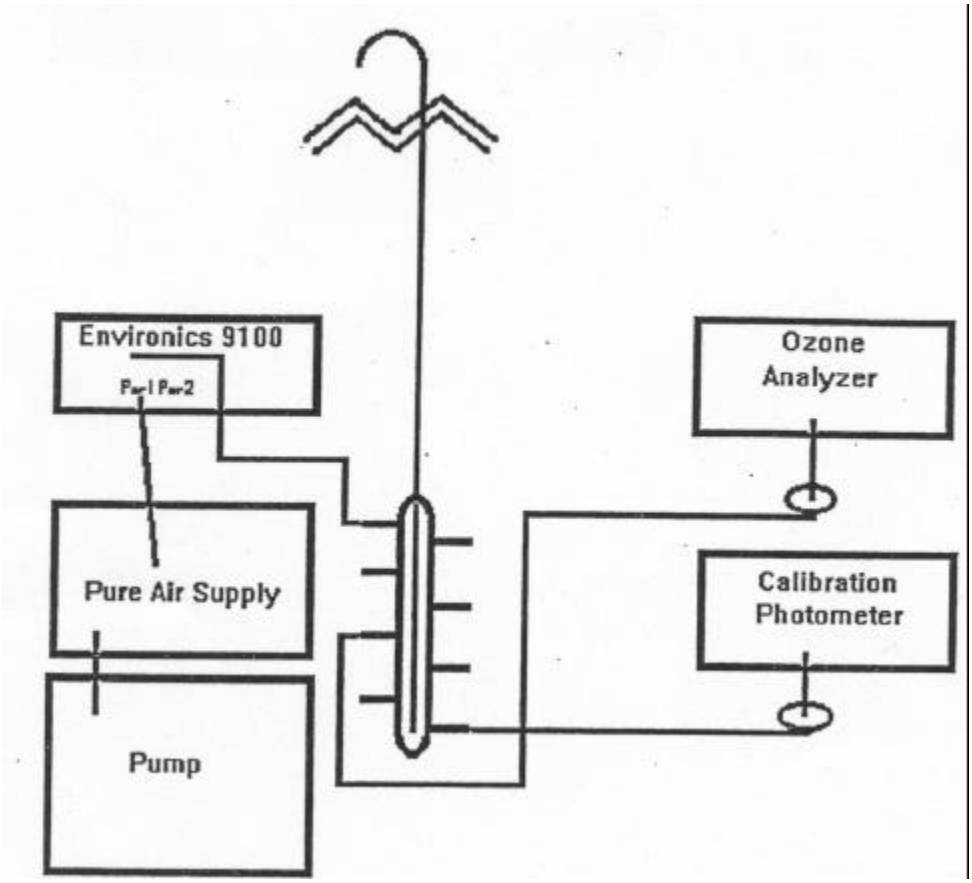

Figure AC.4.0.2
Environics Calibration Diagram

Table AC.4.0.3
Ozone Generator Calibration Report

ARB Calibration Report – Environics Gas Calibration System

Ozone Generator Calibration:

Ozone Transfer Standard I.D.:

Make & Model:	5009 CP	Span Dial Number:	308
Property No.:	20003850	P/T (On/Off):	On
Serial No.:	309	P/T Corr. Value:	1.383
Gas Pres. (mmHg):	610.0	Air Flow (volts):	
Gas Temp (C):	26.9	Gas Flow (volts):	
Air Flow (slpm):	2.0	Cert. Date:	10/15/96
Air Flow Setting:	2.5	Cert. Exp.:	1/14/96

Calibration Info.:

Cal Type:	As Is
Calibration Date:	10/22/96
Prev. Calib. Date:	5/20/96

Environics Display:

Ozone Block Temp. (C):	51.000
Air Flow (SLPM):	13.13
O3 Gen. Pres. (PSIA):	23.7
Ozone Flow (CCM):	494.1

True Ozone Correction Factor (TOCF):

	m:	x :		b :	
True O3 =	0.9982	* Avg. Display	+/-	0.0001	ppm O3

Calibration Data (Transfer Standard) for Ozone:

	Number	Pre-Zero	1st 0.600	2nd 0.500	3rd 0.400	4th 0.200	5th 0.090	6th 0.050	Post-Zero
O3 Lamp Voltage:		0.735	12.76	12.66	12.51	11.47	9.95	9.350	0.732
	1	-0.002	0.604	0.510	0.415	0.207	0.089	0.050	0.000
	2	-0.002	0.604	0.510	0.415	0.207	0.089	0.050	0.000
	3	-0.002	0.604	0.510	0.415	0.207	0.089	0.050	-0.001
	4	-0.001	0.604	0.510	0.415	0.207	0.089	0.050	-0.001
	5	-0.002	0.604	0.510	0.415	0.207	0.089	0.050	-0.001
	6	-0.001	0.604	0.510	0.414	0.207	0.090	0.050	-0.001
	7	-0.001	0.604	0.510	0.414	0.207	0.089	0.050	-0.001
	8	-0.001	0.604	0.510	0.414	0.207	0.090	0.050	-0.001
	9	-0.001	0.604	0.510	0.414	0.207	0.089	0.050	-0.001
	10	-0.001	0.604	0.510	0.414	0.207	0.089	0.050	-0.001
Average Display:		-0.001	0.604	0.510	0.415	0.207	0.089	0.050	-0.001
Corr. Ave. (ppm):			0.604	0.510	0.415	0.208	0.090	0.051	

Graph Values for Ozone Conc.:

Setpoint: (x)	True O3: (y)	Line Calc.
0.60	0.604	0.610
0.50	0.510	0.509
0.40	0.415	0.408
0.20	0.208	0.205
0.09	0.090	0.094
0.05	0.051	0.053

Ozone Regression Output:

Constant		0.00233
Std Err of Y Est		0.00538
R Squared		0.99956
No. of Observations		6
Degrees of Freedom		4
Correlation	0.99978	
X Coefficient(s)	1.013335	
Std Err of Coef.	0.010630	

Pre-Post Zero

Pre:	-0.001
Post:	-0.001
Average:	-0.001

Ozone Regression

Ozone Flow Regression Equ.:

TOF (Slope):	1.0133
Intercept:	0.0023

Comments:			
Calibrated by:	LMJ	Checked by:	

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AC.4.0.8 AS IS OZONE CALIBRATION

1. Disconnect the pure air supply from Port 2. Connect the superblend gas cylinder line to Port 2, and turn on the gas. Connect the pure air supply to Port 1. The datalogger needs to be disabled for this procedure. Ensure the analyzer's inline filter has been changed recently, and record the station manifold pressure from the 1-0-1 inch water Magnehelic gauge.

2. Use the "Ozone As Is" form in the Environics 9100 laptop spreadsheet, and fill in as much information as possible before the start of the calibration (ref: Table AC.4.0.3).

3. Connect the Environics 9100 to the other calibration instrumentation as illustrated in Figure AC.4.0.2. The following set of steps and Figure AC.4.0.2 assume that an ozone analyzer will be calibrated along with the Environics 9100. If the station ozone analyzer does not need to be calibrated, make the appropriate adjustments.

    a) Pure air flows from the Aadco air purifier to the inlet of the 9100. (Port1) @ 35psig.

    b) The ozone/air mixture flows from the 9100 through a piece of Teflon tubing into the highest open port of the station's air inlet manifold.

    c) The bottom port of the manifold is connected to the inlet of the ozone analyzer's filter, then to the ozone analyzer's sample inlet.

    d) A port near the bottom of the glass manifold is connected to the ozone transfer standard via 1/4 inch OD Teflon tubing.

    e) The high ozone point is run for approximately 45 minutes. The manifold backpressure should not exceed 1 inch of water.

    f) All excess gas is to be vented through the probe line, the station exhaust, or an additional large diameter tube to the outside.

4. From the Main Menu PRESS **FLOW MODE**.

5. Set the Total Flow to **13.0** SLPM. Make sure the gas flow is set to **0.00** ppm (this is done by setting the NO "Target Gas" concentration to **0.00**), and the ozone to **0.00** ppm.

6. PRESS **START**. Verify the Aadco output pressure is at 35 psig. Be sure the ozone adjust pressure gauge is on. Operate the Environics 9100 in this mode until a stable zero reading is produced on the transfer standard, the chart recorder, the datalogger, and if the ozone analyzer is being calibrated, on the 1003AH or API 400. Note the station manifold pressure. It must be positive. If not, turn off the station by-pass pump. Record the lamp voltage and ozone generator pressure.

7. Record 10 consecutive zero readings on the laptop spreadsheet.

8. Next, set the ozone value to **0.60** ppm, and PRESS **UPDATE**. It may take up to 30 minutes to achieve a stable reading at this level. After the ozone output has stabilized on the transfer standard, chart recorder, and the datalogger record 10 consecutive readings. Record the ozone lamp voltage.

9. Repeat the preceding steps for the **0.50**, **0.40**, **0.20**, **0.09** and **0.05** ppm concentration levels. The run time for these steps should be 20 minutes.

10. After all of the points have successfully been collected, set the ozone concentration to **0.0** ppm. When the values indicate a stable zero, or about 20 minutes, record 10 consecutive readings.

11. PRESS **STOP** to exit this operation.

12. PRESS **EXIT** to exit the FLOW Mode, and return to the Main Menu.

13. If the ozone concentration is not +/- .005 ppm @ .09 ppm, or +/- .050 ppm at 0.50 ppm, then the ozone generator will need a final calibration.

AC.4.0.9 FINAL OZONE CALIBRATION

1. Entering new ozone data. From the Main Menu, PRESS the **CALIBRATION MODE** soft key.

2. At the "Password" prompt, enter the password.

3. PRESS **OZONE**.

4. Enter the **0.05, 0.09**, **0.20**, **0.40**, **0.50** and **0.60** "Target" ozone values. The "Total Flow" must be set to 13.0 SLPM. Enter the "True" ozone values as calculated from the ozone transfer standard obtained during the "As Is" calibration. Enter the ozone generator pressure. At altitude, if the transfer standard does not have automatic pressure and temperature correction built-in, use the altitude correction factor equation or look up the appropriate value from Altitude Correction Factor Table AC.4.0.4.

5. PRESS **SAVE DATA**. PRESS **YES**.

   The display will read: "Last calibration was performed on (today's date).

6. Press **EXIT**(s) to return to the Main Menu.

7. Once the new ozone data has been entered into the 9100's microprocessor, a confirming "final" calibration needs to be performed.

8. From the Main Menu PRESS **FLOW MODE**.

9. Set the target flow to **13.0** SLPM, the gas flow to **0.00** SCCM, and the ozone to **0.00** ppm.

10. PRESS **START**. Operate the Environics 9100 in this mode until a stable zero reading is produced on the transfer standard, the chart recorder, the datalogger, and if needed, on the 1003AH or API 400 ozone analyzer. A 20-minute sampling period is sufficient to achieve a stable zero reading.

11. Use the "Ozone-Final" form in the Environics 9100 lap top spreadsheet and fill in as much information as possible before the start of the final calibration (ref: Table AC.4.0.3).

12. Next, set the ozone value to **0.60** ppm, and PRESS **UPDATE**. It may take up to 30 minutes to achieve a stable reading at this level. After the values have stabilized on the transfer standard, chart recorder, and the datalogger record 10 consecutive readings. Record the ozone lamp voltage.

13. Repeat the preceding steps for the **0.50**, **0.40**, **0.20**, **0.09** and **0.05** ppm concentration levels.

14. After all of the points have successfully been collected, set the ozone concentration to **0.0** ppm. When the values indicate a stable zero, record 10 consecutive readings.

15. PRESS **STOP**, **EXIT**, **EXIT** to return to the Main Menu.

Table AC.4.0.4
Altitude Correction Factors

Altitude (feet)	ACF	Pressure mm Hg
0	1.0010	760
100	0.9973	758
200	0.9936	755
300	0.9899	752
400	0.9863	750
500	0.9826	747
600	0.9790	744
700	0.9753	741
800	0.9717	739
900	0.9681	736
1000	0.9645	733
1100	0.9610	730
1200	0.9574	728
1300	0.9539	725
1400	0.9503	722
1500	0.9468	720
1600	0.9433	717
1700	0.9398	714
1800	0.9363	712
1900	0.9329	709
2000	0.9294	706
2100	0.9260	704
2200	0.9225	701
2300	0.9191	699
2400	0.9157	696
2500	0.9123	693
2600	0.9090	691
2700	0.9056	688
2800	0.9022	686
2900	0.8989	683
3000	0.8956	681
3100	0.8922	678
3200	0.8889	676
3300	0.8857	673
3400	0.8824	671
3500	0.8791	668
3600	0.8758	666
3700	0.8726	663
3800	0.8694	661
3900	0.8662	658
4000	0.8629	656
4100	0.8598	653
4200	0.8566	651
4300	0.8534	649
4400	0.8502	646
4500	0.8471	644
4600	0.8440	641
4700	0.8408	639
4800	0.8377	637
4900	0.8346	634
5000	0.8315	632
5100	0.8284	630
5200	0.8254	627
5300	0.8223	625
5400	0.8193	623
5500	0.8162	620
5600	0.8132	618
5700	0.8102	616
5800	0.8072	613
5900	0.8042	611
6000	0.8012	609
6100	0.7983	607
6200	0.7953	604
6300	0.7924	602
6400	0.7894	600
6500	0.7865	598
6600	0.7836	596
6700	0.7807	593
6800	0.7778	591
6900	0.7749	589
7000	0.7721	587
7100	0.7692	585
7200	0.7663	582
7300	0.7635	580
7400	0.7607	578
7500	0.7579	576
7600	0.7551	574
7700	0.7523	572
7800	0.7495	570
7900	0.7467	567
8000	0.7439	565
8100	0.7412	563
8200	0.7384	561
8300	0.7357	559
8400	0.7330	557
8500	0.7303	555
8600	0.7276	553
8700	0.7249	551

AC. 4.0.10 POST CALIBRATION

1. If time permits, perform a manual calibration with the Environics. To accomplish this, PRESS **PROGRAM MODE**, then PRESS **SEQUENCE**, and then PRESS **RECALL**. Select either a span or precision calibration. A precision is preferable since 5/7 of the daily calibrations are precision calibrations. PRESS **ACCEPT** for the appropriate "Register". Press **START.** After the Sequence Program has run, compare the values received from the datalogger with the pollutant values calculated from the superblend concentrations, new air flow rate, and new gas flow rates.

2. Program the 9100 to operate for the next day, PRESS **PROGRAM MODE**.

3. PRESS **TIMER CONTROL**. PRESS **RECALL**.

4. Look for the "WEEKLY" program. PRESS **Accept 01** (if this is the "WEEKLY" program). Then, PRESS **START**. Look for the message "waiting for (tomorrow's day) 03:50" towards the bottom of the screen.

5. Return all sampling tubings to their original operating connections. Verify that the Environics 9100 output empties into the station probe inlet line.

6. Plug the "Digital In" connector back into its location in the rear of the datalogger.

7. Turn on the by-pass pump if it was disabled.

8. Verify that the superblend is ready for use.

9. Verify that the Environics 9100 air supply is set to 35 psig.

10. Enable all disabled datalogger channels.

11. Fill out a 3" by 5" "Calculated Values for the Calibrator Output" card, and give it to the station operator (example below).

12. Printout a copy of the laptop calibration report Tables AC.4.0.1, 4.0.2, 4.0.3, and 4.0.5, and Figure AC.4.0.1, verify that it is correct, and leave it with the station operator.

Calculated Values for Calibrator Output

Date: 8/29/97 Calibrator # 20002619
Site Name: SACRAMENTO Site Number: 34-305

TIMER:
CO 34.2 ppm NO .670 ppm CH4 11.3 ppm
SO2 — ppm O3 .508 ppm NO2 .508 ppm

PRECISION:
CO 9.2 PPM NO .180 PPM CH4 3.04 PPM
SO2 — PPM O3 .091 PPM NO2 .091 PPM

Timer Gas Flow: 82.45 cc Prec Gas Flow: 22.06 cc
Dilution Air Flow: 12,965 cc

SB Cylinder # CC 28850 Cyl Press : 1200 LB
Analysys Date: 11-9-96 Initials: LJ

Table AC.4.0.5
Calibration Report for Expected Gas Concentrations vs. Instrument Responses

ARB Calibration Report – Environics Gas Calibration System

Expected Gas Concentrations & Instrument Responses:

Air & Gas Flow Rates:

True Air Flow (ccpm):	13,128
True Gas Flow - Span (ccpm):	80.62
True Gas Flow - Precision (ccpm):	21.39

Calibration:

"As Is"	
"Final"	X
Calibration Date:	10/21/96
Prev. Calib. Date:	5/20/96

Gas Concentration: **Calc. Concentration:** **Instrument response:**

Gas:	Cyl. Concentration: (ppm)	Span (ppm)	Precis. (ppm)	Date: 10/25/96 Span	% Diff.	Date: 10/24/96 Precis.	% Diff.
CO	5405	33.0	8.8	33.50	1.6%	9.6	9.2%
CH4	2156	13.2	3.5				
NO	114.6	0.699	0.186	0.707	1.1%	0.194	4.1%
NOx	114.6	0.699	0.186	0.706	0.9%	0.194	4.1%
SO2		0.000	0.000				
O3		0.504	0.091	0.492	-2.3%	0.09	-1.6%
NO2		0.504	0.091	0.525	4.2%	0.092	0.6%

Comments:			
Calibrated by:	LMJ	Checked by:	

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APPENDIX AC.5

ENVIRONICS 9100 GAS CALIBRATOR GUIDELINES FOR REVIEWING DATA

MONITORING AND LABORATORY DIVISION

NOVEMBER 1997

AC.5.0 DATA EVALUATION PROCEDURES

AC.5.0.1 STRIP CHARTS

This section provides guidelines for reviewing the calibration system data traces collected on the strip chart recorder(s). Figure AC.5.0.1 presents a daily precision calibration, and Figure AC.5.0.2 presents a daily span calibration. **Step 1** sends zero air to the inlet of the air monitoring station inlet probe for 18 minutes. **Step 2** sends diluted superblend gas into the probe for the next 18 minute period. **Step 3** continues the superblend dilution, and ozone is added to the mix resulting in a gas phase titration to produce nitrogen dioxide. Finally, in **Step 4**, the superblend dilution is terminated, however, the ozone remains on for the last 18 minute interval.

1. Check the daily zeroes for all the instruments using the gas calibration system. As a rule-of-thumb, zeroes should not vary by more than 0.5 of a chart division from their assigned baselines. If an instrument zero is greater than +/-0.5 chart divisions from the baseline it may indicate: a) the zero air supply is contaminated; or b) the instrument has drifted since the previous calibration. Compare the day-to-day zero shifts against a known good zero air source to rule out the pure air supply as the source of the malfunction.

2. Check to see if the NO, NO2, NOx, O3, CO, CH4, and SO2 traces come up and level out as quickly as illustrated in Figures AC.5.0.3 and AC.5.0.4. If the trace(s) overshoot and then drop down, it may indicate: a) contamination of superblend line or probe line, b) an ambient air analyzer malfunction, or c) a problem with the Environics 9100 mass flow controllers.

3. If the trace(s) undershoots, it may indicate a problem with: a) the calibrator mass flow controllers; b) contamination or leaks in the probe line; or c) a dead sample pump.

4. Compare the most recent NO, NO2, NOx, O3, CO, CH4, and SO2 traces, from the Bristol recorder, with the traces received from previous calibrations to ensure that the calibrator ozone and mass flow controller outputs are stable. The precision and span points for gases should be at these approximate values:

Gas	Precision	Span
NO and NOX	0.18 (ppm)	0.70 (ppm)
NO2	0.09	0.50
O3	0.09	0.50
CO	9.0	35.0
SO2	0.09	0.35
CH4	3.5	14.0

5. The ozone value should be 0.09 ppm +/-.005 ppm for the precision point, and 0.50 ppm +/-0.05 ppm for the span point. The Environics 9100 ozone output tends to decrease over time. The decrease in ozone concentration is most pronounced when the unit is new, and improves with time.

6. The nitrogen dioxide value should be within 10% of the ozone value during the gas phase titration. The "spread" between the NO and NOX traces, during span calibrations, should not be more than one chart division.

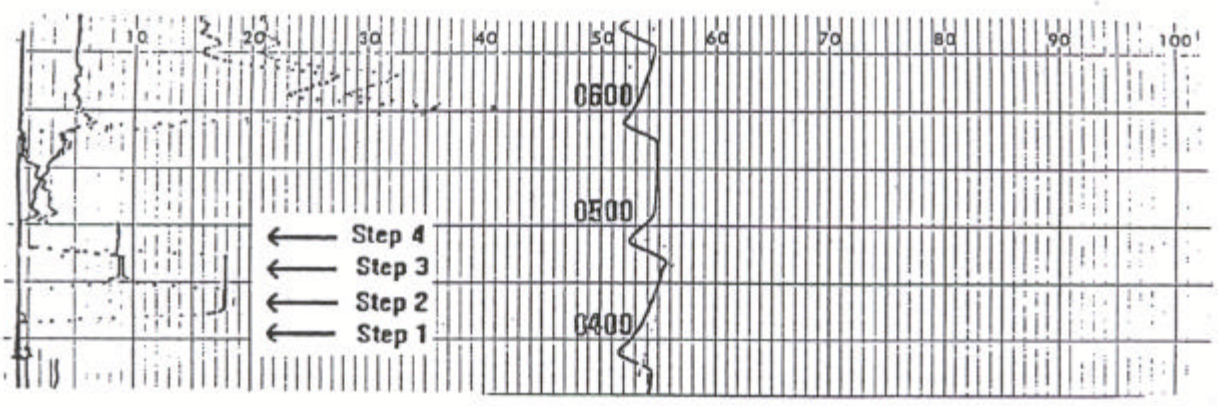

Figure AC.5.0.1
Daily Precision Calibration

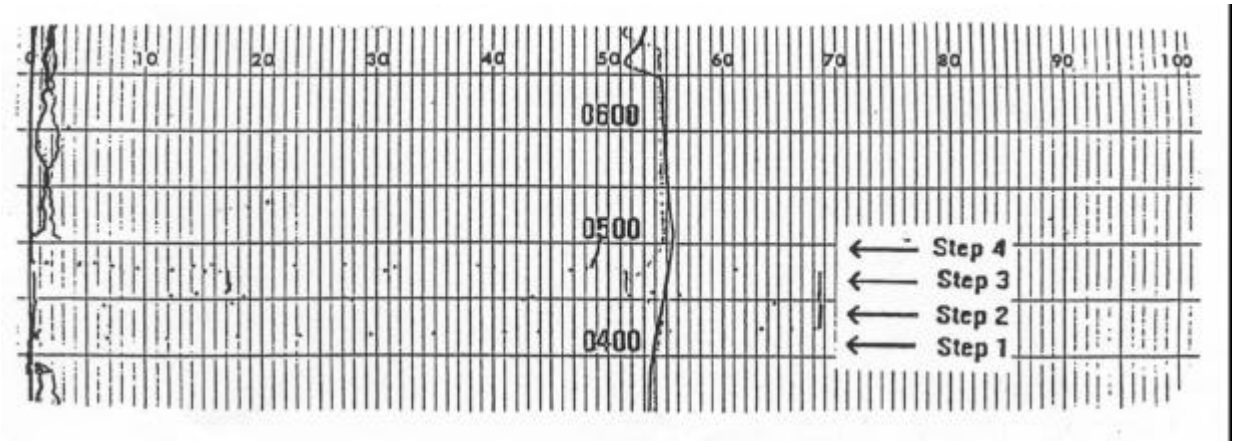

Figure AC.5.0.2
Daily Span Calibration

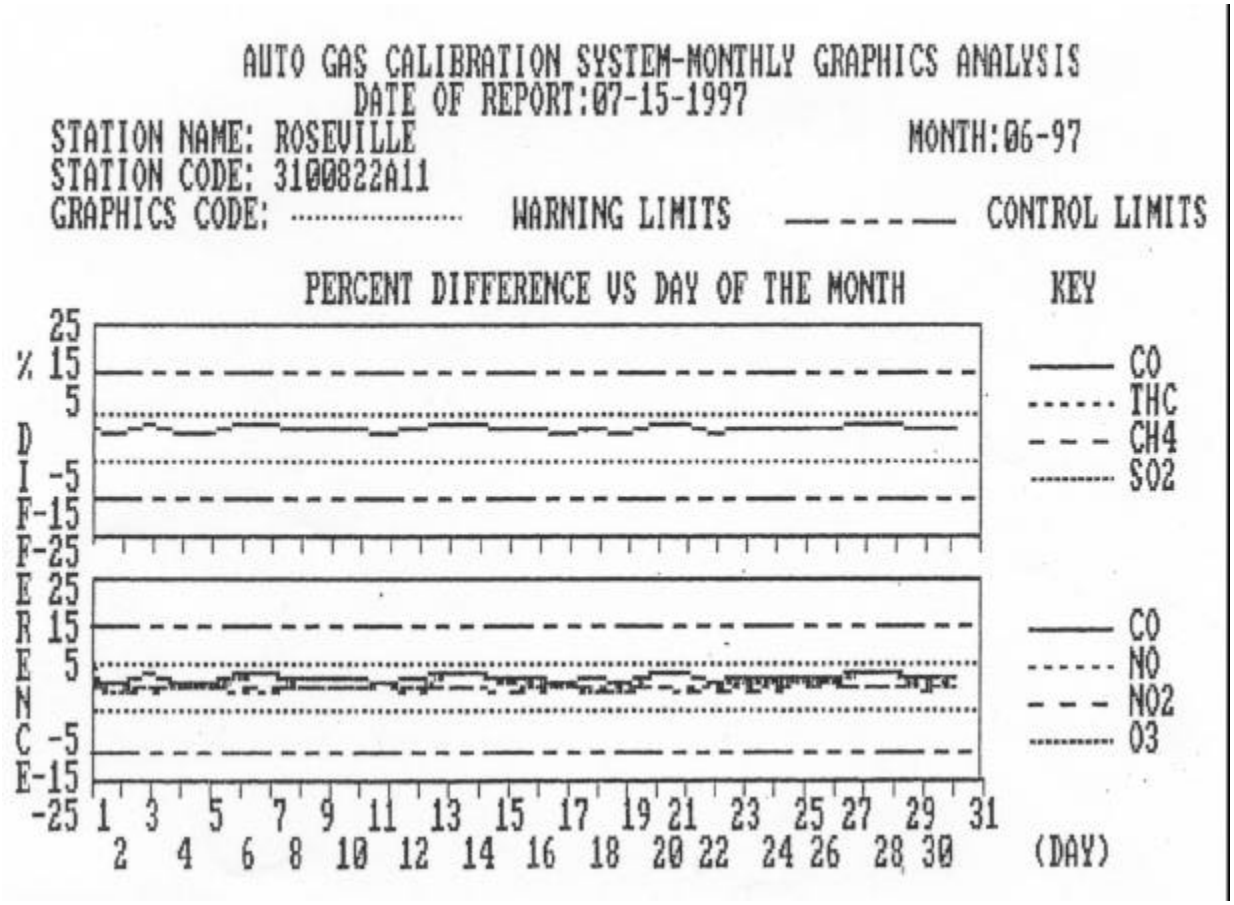

Figure AC.5.0.3
Auto Gas Calibration System-Monthly Graphic Analysis

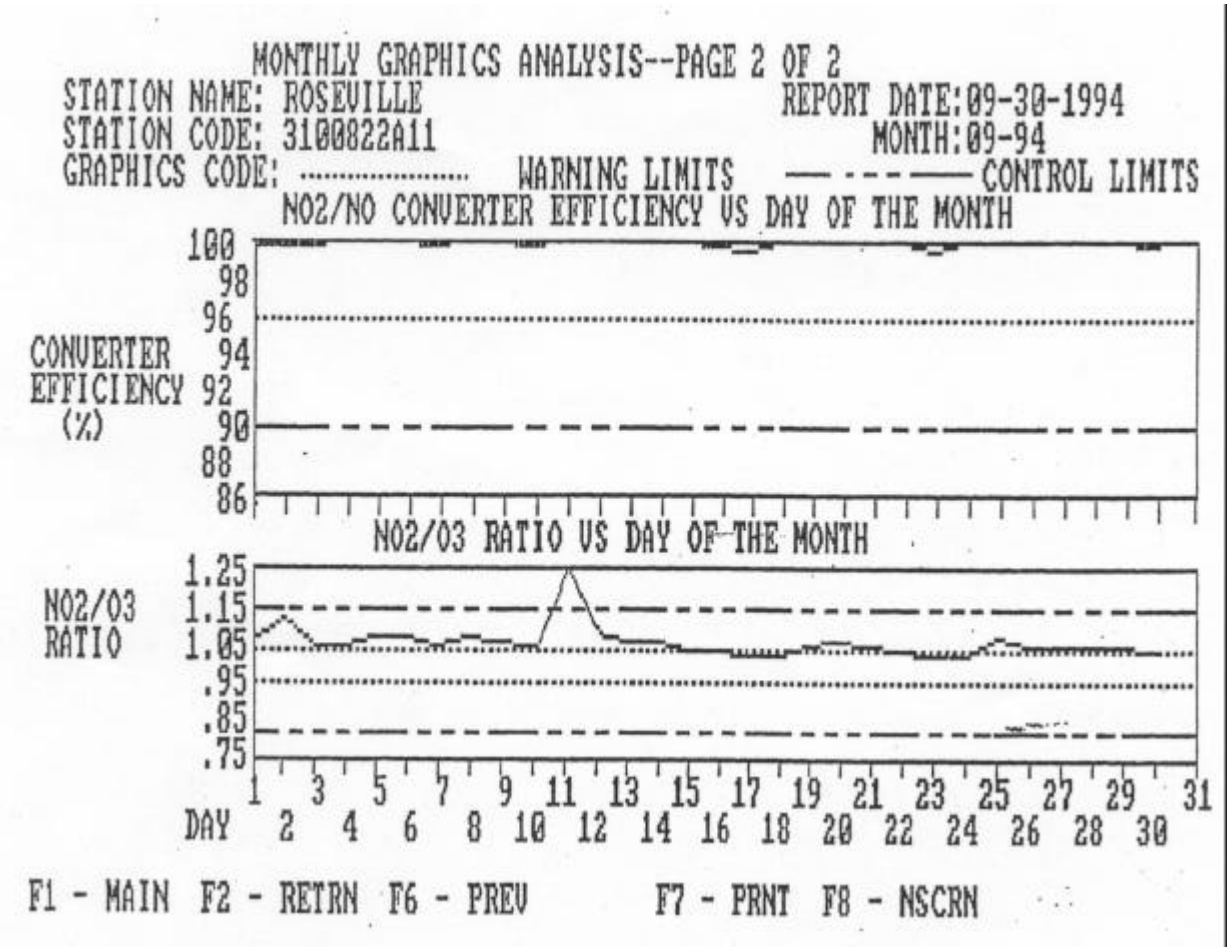

Figure AC.5.0.4
Monthly Converter Efficiency and NO2/O3 Ratio Graphs

AC.5.0.2 MONTHLY DATA ANALYSIS

At the end of the month the air monitoring station technician will print out the monthly quality control graphs for all gaseous pollutants. The graphs will be evaluated by the Air Pollution Specialist or Air Pollution Engineer responsible for the second level of data review. Examples of these graphs are presented in Figure AC.5.0.3, the Auto Gas Calibration System-Monthly Graphic Analysis, and Figure AC.5.0.4, the Monthly Converter Efficiency and NO2/O3 Ratio Graphs.

Upon review of the Auto Gas Calibration System-Monthly Graphic Analysis (Figure AC.5.0.3), one will notice a plot of carbon monoxide (CO) on the top portion of the graph. CO data are plotted showing percent difference versus day of the month. The response of the CO analyzers have proven very stable. Thus, other data are evaluated with respect to carbon monoxide values. The plot at the bottom of the page is for all of the pollutants. If all of the plots of the pollutants move synchronously with CO, then the analyzers are apparently operating fine. If all of the instrument's calibration data fall below 15 percent or rise greater than 15 percent, the chances are that the calibration system is having a problem that needs to be dealt with as soon as possible. System malfunction examples include: a pure air generator failure, loss of station temperature control, a calibrator ozone generator problem, or a calibrator mass flow controller malfunction. If the trace of one analyzer shifts with respect to the other analyzers, one can reasonably assume that the individual analyzer has malfunctioned.

The bottom portion of Auto Gas Calibration-Monthly Graphic Analysis illustrates the graphs of percent differences versus days of the month for all of the pollutants, and can be used to evaluate an ambient air analyzer's response trends. The Out-of-Control limits are set at +/-15 percent. If an analyzer response falls outside this limit, air quality data will be withheld from data processing. Therefore, corrective action should be taken prior to exceeding the control limits. This graph provides a quick means to evaluate the performance of the calibration system's mass flow controllers and ozone generator, and the gaseous ambient air analyzers.

The top portion of Figure AC.5.0.4 illustrates the converter efficiency of the nitrogen dioxide analyzer. The California state standard for nitrogen oxides is for nitrogen dioxide (NO2). NO2 is determined by the subtractive method of nitric oxide (NO) from all nitrogen oxide species (NOX). Since this analyzer works by the principle of chemiluminescence, all NOX must be converted to NO before it can be detected. This conversion takes place in the nitrogen oxides analyzer converter. For NO2 data collected from ambient air to be valid, the analyzer must demonstrate a converter efficiency greater than 96 percent.

The ozone concentration generated in Steps 3 and 4 of the precision and span programs should be constant. As a result, the ratio of the NO2 generated in Step 3 and the ozone generated in Step 4 should be constant. The bottom portion of Figure AC.5.0.4 illustrates the NO2/O3 ratio versus the day of the month. The expected value of this test is near 1.0. Listed below are several ways the ratio may be evaluated:

NO2/O3 Ratio	O3 Reading	NO2 Reading	Probable Cause
constant	decreasing	decreasing	malfunctioning ozone generator
increasing	decreasing	constant	O3 analyzer
increasing	constant	increasing	NO/NOX analyzer needs calibration
decreasing	constant	decreasing	bad NOX converter or NO/NOX analyzer needs calibration
decreasing	increasing	constant	malfunctioning ozone generator

AC.5.0.3 BASIC EQUATION

To calculate new precision and span calibration values that need to be entered into the ESC datalogger to generate the control charts shown above, use the following equation for each pollutant:

Definitions:

a. Fg = gas flow, standard cubic centimeters per minute
b. Fa = air flow, standard cubic centimeters per minute
c. Ft = total air flow, = Fa + Fg, standard cubic centimeters per minute
d. Ccyl = compressed gas cylinder concentration, ppm
e. Co = resultant concentration or desired concentration, ppm

$$Co = \frac{Fg \times Ccyl}{Fa + Fg}$$