TELEDYNE
ADVANCED POLLUTION INSTRUMENTATION
A Teledyne Technologies Company

MANUAL ADDENDUM

MODEL 265E CHEMILUMINESCENCE OZONE ANALYZER

(Addendum to Model 200E Operation Manual PN 04410)

© TELEDYNE ADVANCED POLLUTION INSTRUMENTATION
9480 CARROLL PARK DRIVE
SAN DIEGO, CA 92121-5201
USA

Toll-free Phone: 800-324-5190
Phone: 858-657-9800
Fax: 858-657-9816
Email: api-sales@teledyne.com
Website: http://www.teledyne-api.com/

06626B DCN6325
December 07, 2011

IMPORTANT SAFETY INFORMATION

Important safety messages are provided throughout this manual for the purpose of avoiding personal injury or instrument damage. Please read these messages carefully. Each safety message is associated with a safety alert symbol, and are placed throughout this manual and inside the instrument. The symbols with messages are defined as follows:

WARNING: Electrical Shock Hazard

HAZARD: Strong oxidizer

GENERAL WARNING/CAUTION: Read the accompanying message for specific information.

CAUTION: Hot Surface Warning

Do Not Touch: Touching some parts of the instrument without protection or proper tools could result in damage to the part(s) and/or the instrument.

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

Electrical Ground: This symbol inside the instrument marks the central safety grounding point for the instrument.

CAUTION

This instrument should only be used for the purpose and in the manner described in this manual. If you use this instrument in a manner other than that for which it was intended, unpredictable behavior could ensue with possible hazardous consequences.

NEVER use any gas analyzer to sample combustible gas(es)!

Note

For Technical Assistance regarding the use and maintenance of this instrument or any other Teledyne API product, contact Teledyne API's Customer Service Department:

Phone: 800-324-5190

Email: api-customerservice@teledyne.com

or by accessing various service options on our website at http://www.teledyne-api.com/.

REVISION HISTORY

This section provides information regarding changes to this manual.

2011 December 07, M265E Addendum, 06626		
Rev	**DCN**	**Description of Changes**
B	**6325**	**Specs update: Zero Noise, LDL, Zero and Span Drifts**
2011 November 08, M265E Addendum, PN06626A, DCN6119, Initial Release		

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1. INTRODUCTION

This section presents a brief overview of the Model 265E; supplemental information may be found in the Model 200E Operation Manual.

1.1. OVERVIEW

The Model 265E is a close derivative of the Model 200E Chemiluminescence NOx Analyzer. This addendum provides an overview of the instrument with details of the features and functions that are specific to the Model 265E; it is intended as a supplement to the Model 200E operation manual (Teledyne API part number 04410). Note: it is imperative that before placing the analyzer into service, users familiarize themselves with the Model 200E manual, which describes in detail specific functionality common to both products, such as hardware adjustment during calibration, initializing communications with the product and trouble-shooting approaches.

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2. SPECIFICATIONS AND APPROVALS

Table 2-1 presents the specifications for the Model 265E analyzer, and Sections 2.1 and 2.2 present approvals and certifications.

Table 2-1. Model 265E Specifications

PARAMETER	SPECIFICATION
Ranges	0-100 ppb to 0-2,000 ppb full scale, user selectable.
Measurement Mode	Single Range or AutoRange
Measurement Units	ppb, ppm, µg/m^3 mg/m^3
Zero Noise [1]	<0.15 ppb (RMS)
Span Noise [1]	<0.5% of reading (RMS) above 100 ppb
Lower Detectable Limit	<0.3 ppb
Zero Drift (24 hours)	<0.5 ppb
Span Drift (24 hours)	<0.5% of full scale
Linearity	<1% of full scale
Precision	<0.5% of reading
Lag Time [1]	<10 sec
Rise/Fall Time [1]	<20 sec to 95%
Sample Flow Rate	500 cm³/min ± 10%
Reagent Gas	NO at 10,000 ppm ±10%
Reagent Flow	5 ± 2 cm³/min
Environmental	Installation Category (Over-voltage Category) II
	Pollution Degree 2
Temperature Range	5 – 40° C (with EPA equivalency)
Humidity Range	10-90% RH non-condensing
Dimensions H x W x D	7" x 17" x 23.5" (18 cm x 43 cm x 61 cm)
Weight, Analyzer	40 lbs (18 kg) (with internal pump)
AC Power	100 V – 120 V, 60Hz, 3.0A 220 V – 240 V, 50 Hz, 2.5A
Analog Outputs	Four (4) Outputs
Analog Output Ranges	All Outputs: 100 mV, 1 V, 5 V, 10 V Two concentration outputs convertible to 4-20 mA isolated current loop option All Ranges with 5% Under/Over Range
Analog Output Resolution	1 part in 4096 of selected full scale voltage
Current Loop Option	4-20 mA, isolated
Status Outputs	8 Status outputs from opto-isolators, 7 defined, 1 spare
Control Inputs	6 Control Inputs, 4 defined, 2 spare
Serial I/O	COM1: RS232 (Multidrop option available) COM2: RS-232 or RS-485 (Ethernet option and ModBus® interface available)
[1] As defined by the US EPA	

2.1. EPA EQUIVALENCY DESIGNATION

Teledyne API's Model 265E Chemiluminescence Ozone Analyzer received EPA approval for Designation EQOA-0611-199. The designation will be considered valid when the instrument is operated under the following conditions:

- on any full scale range between 0-100 ppb and 0-1000 ppb
- with any range mode (Single, Dual, or Auto Range)
- at any ambient temperature in the range of 5°C to 40°C
- with a TFE filter in the sample air inlet
- with a sample flow rate of 500 ± 50 cm^3/min (sea level)
- with the dilution factor set to 1
- with Temp/Press compensation ON
- in accordance with the appropriate associated instrument manuals
- with or without any of the following options:
    - Internal or external sample pump
    - Sample/Cal valve option
    - Rack mount with or without slides
    - 4-20 mA isolated current loop output

2.2. COMPLIANCE STATEMENTS

The Teledyne - API Model 265E analyzer was tested and certified for Safety and Electromagnetic Compatibility (EMC). This section presents the compliance statements for those requirements and directives.

2.2.1. **Safety**

IEC 61010-1:2001

2.2.2. **EMC**

EN61326 (1997 w/A1: 98) Class A, FCC Part 15 Subpart B Section 15.107 Class A, ICES-003 Class A (ANSI C63.4 1992) & AS/NZS 3548 (w/A1 & A2; 97) Class A.

2.3. WARRANTY

Refer to the Model 200E operation manual regarding the Warranty policy for the Model 265E.

3. GETTING STARTED

This section addresses the procedures for unpacking the instrument and inspecting for damage, and introduces the instrument layout, then presents the procedures for getting started: making electrical and pneumatic connections, and conducting an initial calibration check. Please see the Model 200E Operation Manual for more information.

3.1. UNPACKING

CAUTION – GENERAL SAFETY HAZARD

To avoid personal injury, always use two persons to lift and carry the Model 265E.

ATTENTION

COULD DAMAGE INSTRUMENT AND VOID WARRANTY

Printed Circuit Assemblies (PCAs) are sensitive to electro-static discharges too small to be felt by the human nervous system. Failure to use ESD protection when working with electronic assemblies will void the instrument warranty

See *A Primer on Electro-Static Discharge* in the accompanying Model 200E manual for more information on preventing ESD damage.

CAUTION - ELECTRICAL SHOCK HAZARD

Never disconnect PCAs, wiring harnesses or electronic subassemblies while analyzer is under power.

CAUTION

Do not operate this instrument until you've removed dust plugs from SAMPLE and EXHAUST ports on the rear panel!.

Note

It is recommended that you store shipping containers/materials for future use if/when the instrument should be returned to the factory for repair and/or calibration service. See Warranty section in this manual and shipping procedures on our Website at http://www.teledyne-api.com under Customer Support > Return Authorization.

1. First, verify that there is no apparent external shipping damage. If damage has occurred, please advise the shipper first, then Teledyne-API. Save the packaging for shipper's examination.

2. Included with your analyzer is a printed record of the final performance characterization performed on your instrument at the factory. This record, titled *Final Test and Validation Data Sheet* (P/N 06627) is an important quality assurance and calibration record for this instrument. It should be placed in the quality records file for this instrument.

3. Carefully remove the top cover of the analyzer and check for internal shipping damage.
   - Remove the set screw located in the top, center of the front panel.
   - Remove the two screws fastening the top cover to the unit (one per side towards the rear).
   - Slide the cover backward until it clears the analyzer's front bezel.
   - Lift the cover straight up.
   - Check for internal shipping damage, and generally inspect the interior of the instrument to make sure all circuit boards and other components are in good shape and properly seated.
4. Reinstall the cover and screws, once the inspection is complete.

5. Check the voltage and frequency label on the serial number tag on the rear panel. Compare that to your local power before plugging the instrument into an outlet.

3.2. INSTRUMENT LAYOUT

Instrument layout includes front panel and display, rear panel connectors, and internal chassis layout.

3.2.1. **Front Panel**

Figure 3-1 illustrates the front panel of the Model 265E analyzer.

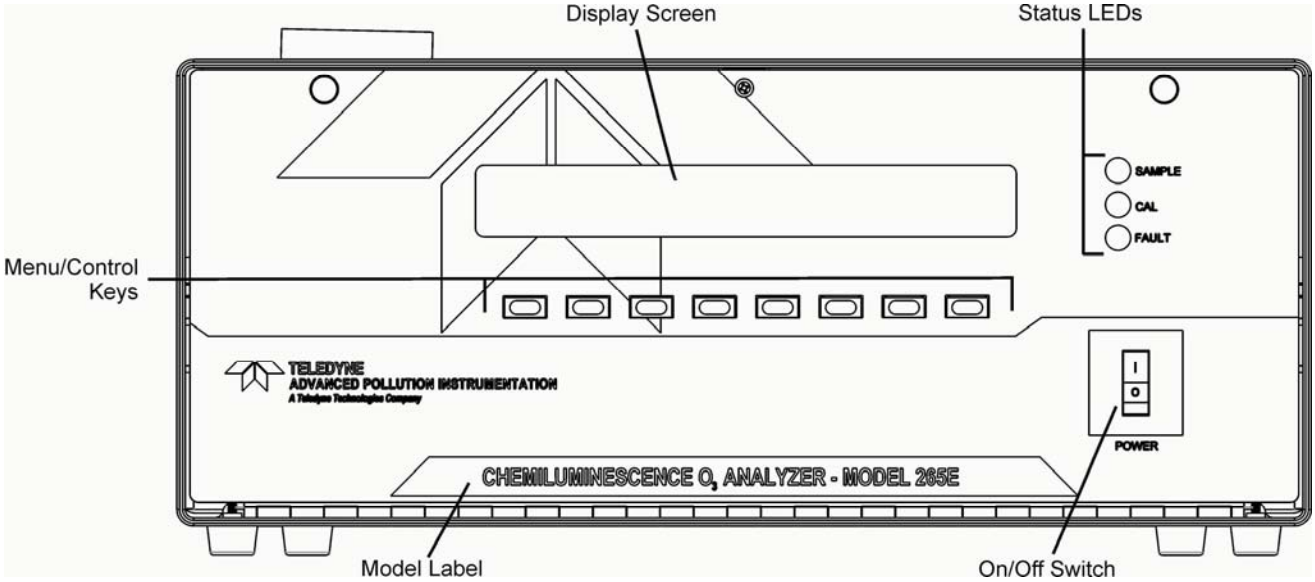

Figure 3-1. Front Panel

3.2.2. **Rear Panel**

Figure 3-2 illustrates the layout of the Model 265E analyzer's rear panel.

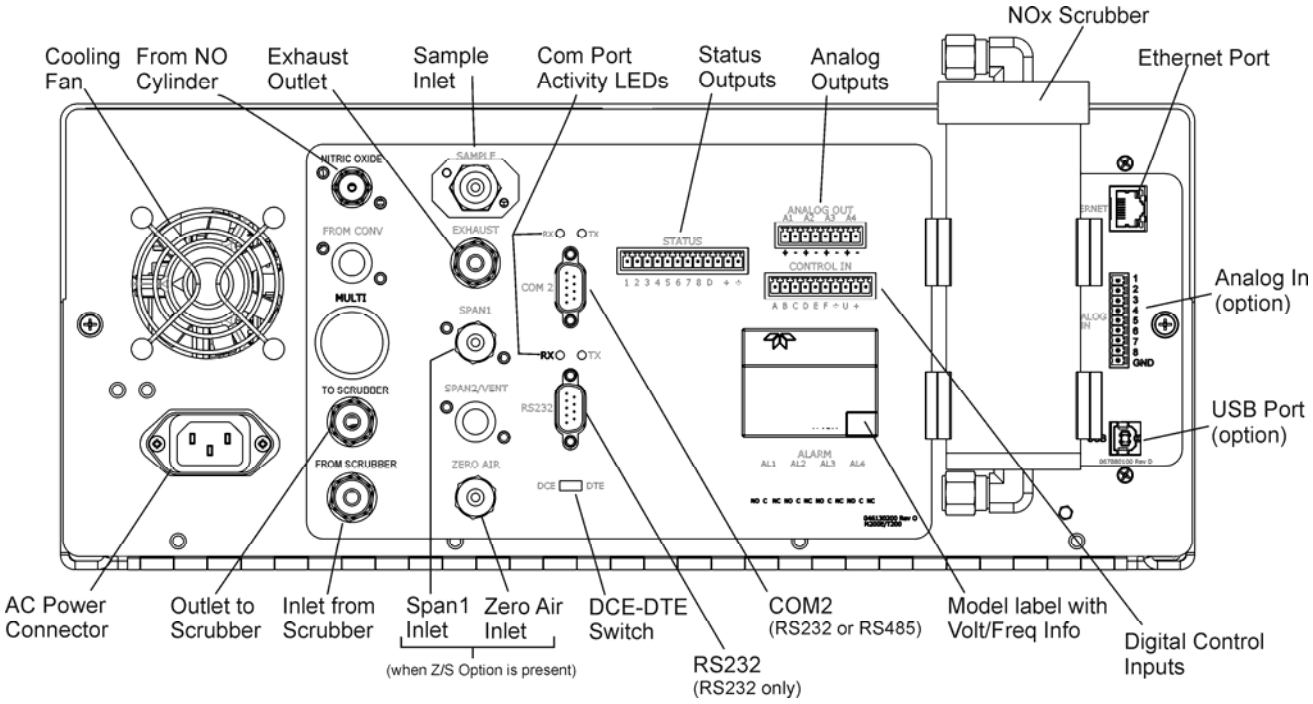

Figure 3-2. Rear Panel

3.2.3. **Internal Chassis Layout**

Figure 3-3 illustrates the location of the internal chassis components.

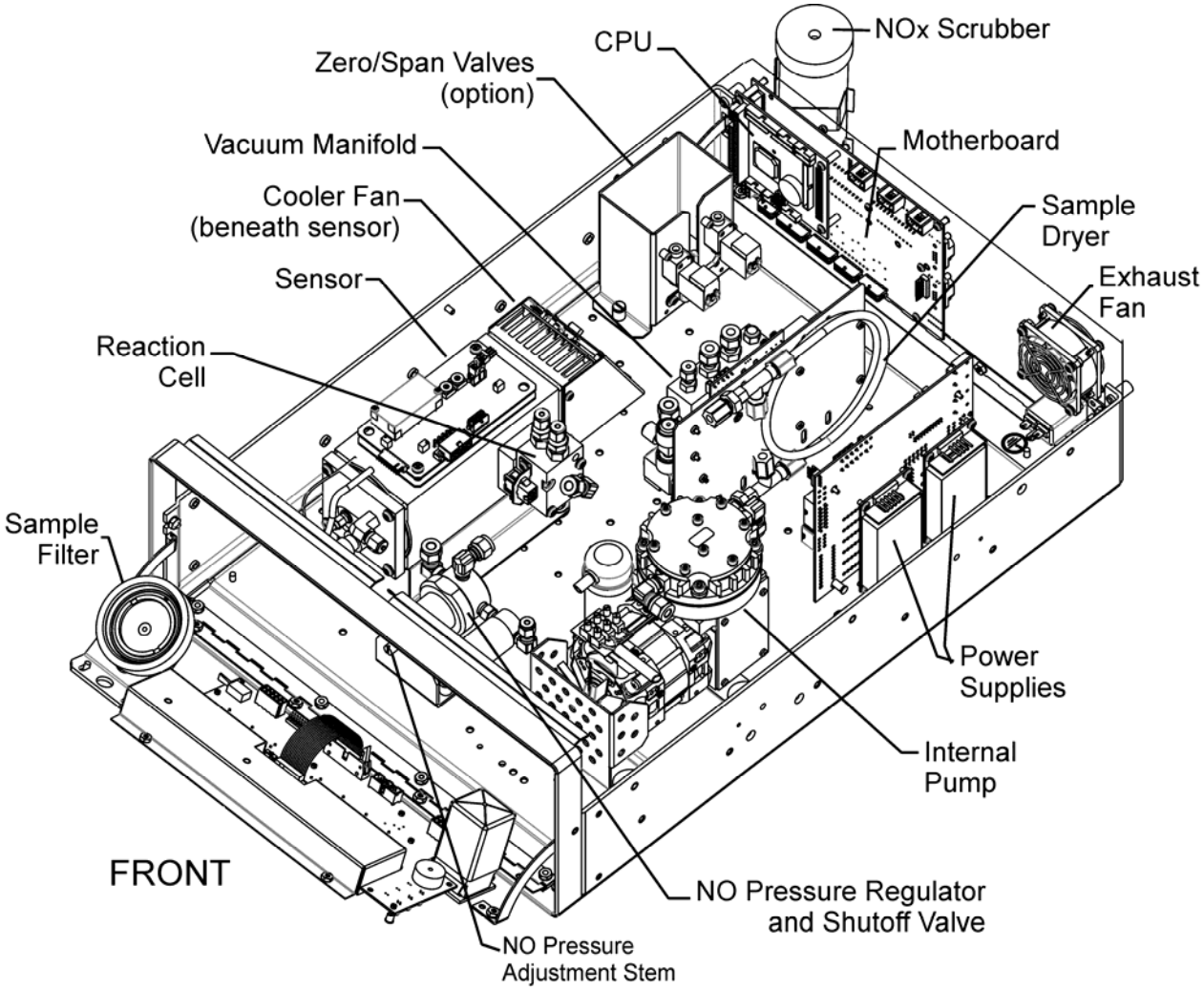

Figure 3-3. Internal Layout

3.3. CONNECTIONS AND SETUP

This section presents connection information to set up the instrument for operation.

3.3.1. Electrical and Pneumatic Connections

1. Refer to Figure 3-2 for the rear panel electrical and pneumatic connectors.
2. Mount the NOx scrubber with base down (arrow labeled "FLOW" pointing down) onto the rear panel.
3. Connect tubing from NOx scrubber base fitting to rear panel fitting labeled "FROM SCRUBBER".
4. Connect tubing from NOx scrubber top fitting to rear panel fitting labeled "TO SCRUBBER".
5. Vent the EXHAUST port to atmospheric pressure and out of the room, because of its nitric oxide content.

CAUTION
GENERAL SAFETY HAZARD

Analyzer Exhaust Contains Nitric Oxide Gas.
Vent pump exhaust to a well-ventilated area at atmospheric pressure.
Obtain a Material Safety Data Sheet (MSDS) for this material. Read and rigorously follow the safety guidelines described there.

6. Attach the sample inlet line to the SAMPLE inlet port. The pressure of the sample gas at the inlet port should be at ambient pressure and constant.
7. Using 1/8" stainless steel tubing, attach a cylinder with 10,000 ppm ±10% of nitric oxide (NO) in nitrogen (N_2), with an appropriate pressure regulator, to the 1/8" stainless steel port (labeled NITRIC OXIDE) on the rear panel as shown in Figure 3-2. Note: The NO cylinder's pressure regulator should be set to deliver gas at 20 PSIG ± 5 PSIG.
8. Attach a strip chart recorder and/or data-logger to the appropriate analog output connections on the rear panel. See section on analog output connections in the Model 200E manual PN04410 for connector pin-out definitions.
9. Connect the power cord to the correct line voltage.

WARNING

Lethal voltages present inside the analyzer's case.

- Do not operate with cover off during normal operation.
- Before operation, check for correct input voltage and frequency.
- Do not operate without proper chassis grounding.
- Do not defeat the ground wire on power plug.
- Turn off analyzer power before disconnecting electrical subassemblies.

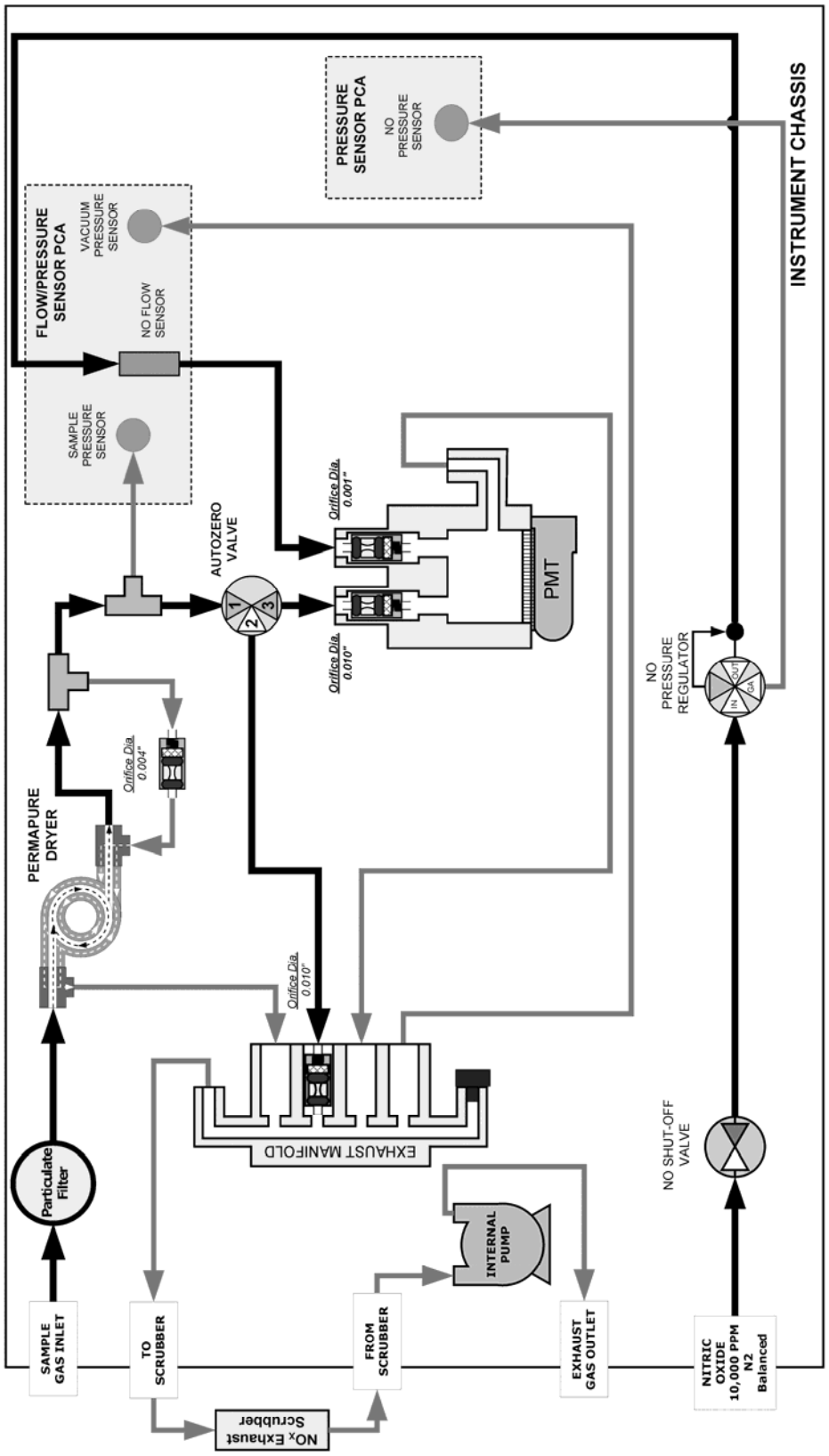

Figure 3-4. Pneumatics, Basic Configuration

3.4. STARTUP, FUNCTIONAL CHECKS, AND INITIAL CALIBRATION

3.4.1. Startup

1. Turn on the instrument by pressing the on/off rocker switch on the front panel. The display should immediately light, showing the computer's memory configuration, then the instrument type - Model 265E. A diagram of the software menu trees can be found in Appendix A of this addendum.

2. Thirty minutes after power-up an internal solenoid valve will open allowing Nitric Oxide gas to flow. Check the Nitric Oxide flow "NO FLOW" test function (TEST button, <TST TST> buttons) on the front panel to verify that the flow is 5 cm^3/min ± 2. cm^3/min.

   - If the flow is out of this range, check the Nitric Oxide pressure "NO PRESS" test function on the front panel display, to verify that the pressure is set to 5 PSIG +/- 1 PSIG.

   - If the pressure is out of this range, check that the cylinder regulator is set to 20 PSIG, then drop the front panel and use a flat head screw driver to turn the NO Pressure Adjustment Stem (Figure 3-3) to adjust the NO pressure regulator: clockwise to increase; counter-clockwise to decrease.

Note

The NO pressure sets the flow; therefore, the 'NO PRESS" test function is of greater importance when setting up the analyzer. The "NO FLOW" test function is only provided to indicate the presence of gas flow.

   - The Model 265E analyzer requires about one hour for all internal components to heat to operating temperature.

IMPORTANT

IMPACT ON READINGS OR DATA

It is recommended that the analyzer operate for about four (4) hours before calibration and the collection of reliable readings.

3. When the instrument is warmed up, check the TEST functions. All of the readings should compare closely with those in the Test Data sheet.

4. After checking the TEST functions, calibrate the instrument as laid out in Step 1 and Step 2 in Section 3.4.2, *Initial Calibration* of this addendum.

3.4.2. **Initial Calibration**

Step 1 - Set the range, then enter the expected ozone span gas concentration:

Step	Action	Comment
1.	Press CAL>CONC	This menu sequence causes the Model 265E to prompt for the expected span concentration. Enter the span value by pressing the button for each digit until the expected value is set.
2.	Press ENTR	ENTR stores the expected span value. The internal formula is adjusted to compute this number when span gas concentration is input into the instrument.
5.	Press EXIT	Returns instrument to SAMPLE mode.
6.	Press SETUP>RNGE> MODE>SNGL	If necessary, you may want to change the Range Mode. Choices are either Single or AutoRange. Normally the instrument is shipped in Single Range Mode.
7.	Press SETUP>RNGE> SET	After the mode is set, you may want to set the maximum Range value. The instrument is shipped with the Range set at 500 ppb. This setting affects only your analog outputs, not the RS-232 output.

Step 2 - Calibrate the instrument: Zero/Span Calibration Procedure

Step	Action	Comment
1.	Input zero gas	Allow zero gas to flow passed the sample port on the rear of the instrument.
2.	Press CAL	The Model 265E enters the calibrate mode from sample mode.
3.	Wait 30 min	Wait for the reading to stabilize at the zero value. If you wait less than 10 minutes the final zero value may drift. You may want to watch the stability "O_3 STB" test function (moving standard deviation) for its minimum value.
4.	Press ZERO	The ZERO button will be displayed once the concentration approaches zero.
5.	Press ENTR	Pressing ENTR zeroes the instrument and adjusts both offset and slope so that Zero concentration is displayed.
6.	Press EXIT, input Span gas	The Model 265E returns to the CAL menu. Now allow span gas to flow passed the instrument.
7.	Wait 30 min	Wait for the O_3 reading to stabilize at the span value (watch O_3 STB).
8.	Press SPAN	The SPAN button should be displayed once the concentration approaches the span value. In certain circumstances at low span concentrations both the ZERO and SPAN buttons will appear. Do not press ZERO again when running span gas!
9.	Press ENTR	Pressing ENTR to span the instrument actually changes the equations so that the concentration displayed is the same as the expected span concentration you entered above, thus spanning the instrument.
10.	Press EXIT	Pressing EXIT returns the instrument to SAMPLE mode.

IMPORTANT

IMPACT ON READINGS OR DATA

Over time PMTs lose sensitivity, which is reflected by an increase in the O_3 slope test function during ongoing calibrations. If the slope falls outside the range of 0.7 to 1.3, a hardware adjustment to the PMT gain is required. The process involves the adjustment of both a high and low gain potentiometer, located on the preamp printed circuit board, while noting the "NORM PMT" test function value, for a particular concentration of Ozone span gas. Typically, the high voltage to the PMT is adjusted, such that, the "NORM PMT" is twice the measured O_3 concentration. See *PMT Sensor Hardware Calibration* in the Model 200E manual's Repair & Troubleshooting section for detailed procedures.

Step 3 - Review Quality of calibration: Calibration Quality Check Procedure

Step	Action	Comment
1.	Scroll the TEST function menu until the O_3 SLOPE is displayed.	The SLOPE value for O_3 should be 1.0 ± 0.3. If the SLOPE value is in the acceptable range the instrument will perform optimally.
2.	Scroll the TEST function menu until the O_3 OFFS is displayed.	The Model 265E will display the offset parameter "O3 OFF" for the O_3 equation. This number should be near zero. A value of ±10 indicates calibration in the optimal range.

The Model 265E is now ready to measure sample gas.

4. MAINTENANCE

4.1. MAINTENANCE SCHEDULE

CAUTION

The operations outlined in this chapter are to be performed by qualified maintenance personnel only.

Please refer to the *Maintenance Schedule & Procedures* section of the Model 200E manual for maintenance items and their interval schedules.

Exceptions:

- "Ozone cleanser" does not apply.
- The reaction cell window (optical filter) may not need to be cleaned annually, but rather on an "as needed" basis.

4.2. MAINTENANCE ITEMS SPECIFIC TO THE MODEL 265E

Annually replace the charcoal in the NOx scrubber, attached to the rear of the analyzer; Kit 005960000.

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5. PRINCIPLES OF OPERATION

The Teledyne API Model 265E analyzer is designed to measure the concentration of ozone using the chemiluminescence reaction below. The signal comes from the light emitted by the gas phase reaction of nitric oxide (NO) and ozone (O_3) as follows:

$$NO + O_3 \longrightarrow NO_2^* + O_2$$

$$NO_2^* \longrightarrow NO_2 + h\nu$$

The reaction of ozone with NO results in electronically excited NO2* molecules as shown in the first equation. The excited NO2* molecules release their excess energy by emitting a photon hν and dropping to a lower energy level as shown in the second equation. It has been shown that the number of emitted photons is directly proportional to the O3 concentration in the sample stream.

Calibration of the instrument is performed in software and usually does not require physical adjustments to the instrument. During calibration, the microprocessor measures the photo multiplier tube (PMT) signal when gases with known amounts of O_3 are supplied, and stores these results in memory. The microprocessor uses these calibration values, along with the signal from the sample gas, the pressure readings for both the reaction cell and sample gas and box temperature in order to calculate a final concentration.

The product requires a cylinder of NO balanced in N_2, which acts as the reagent gas. Both the electronic and pneumatic platforms are built using the current E series hardware. An additional precision regulator is added to keep the NO pressure constant, prior to the reaction cell. The internal pump draws sample through the sample dryer, removing ambient moisture, into the reaction cell. Periodically, an AutoZero valve switches the sample stream to the vacuum manifold, allowing the reaction cell to be evacuated and the analyzer to read zero background. The AutoZero readings are subtracted from the concentration readings, which improves zero baseline stability.

The analyzer uses two temperature-controlled critical orifices to deliver sample O_3 and reagent NO into the reaction cell. A diagram of the pneumatic design is shown in Figure 3-4.

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APPENDIX A: Models T265 and 265E Menu Trees

The following menu trees in this appendix show the structure of the Sample menu and the Setup submenu. For additional details refer to Appendix A of the Model 200E operation manual.

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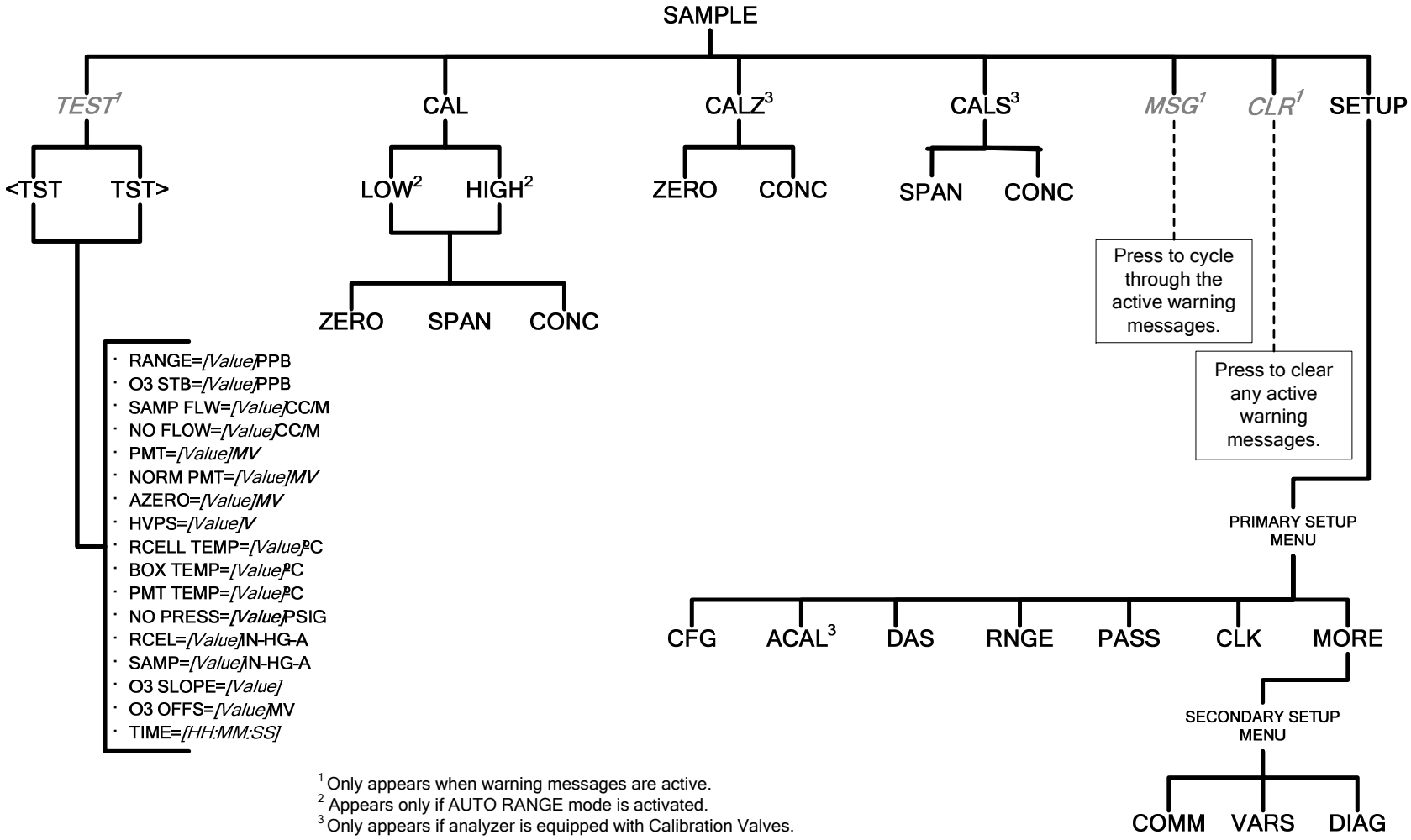
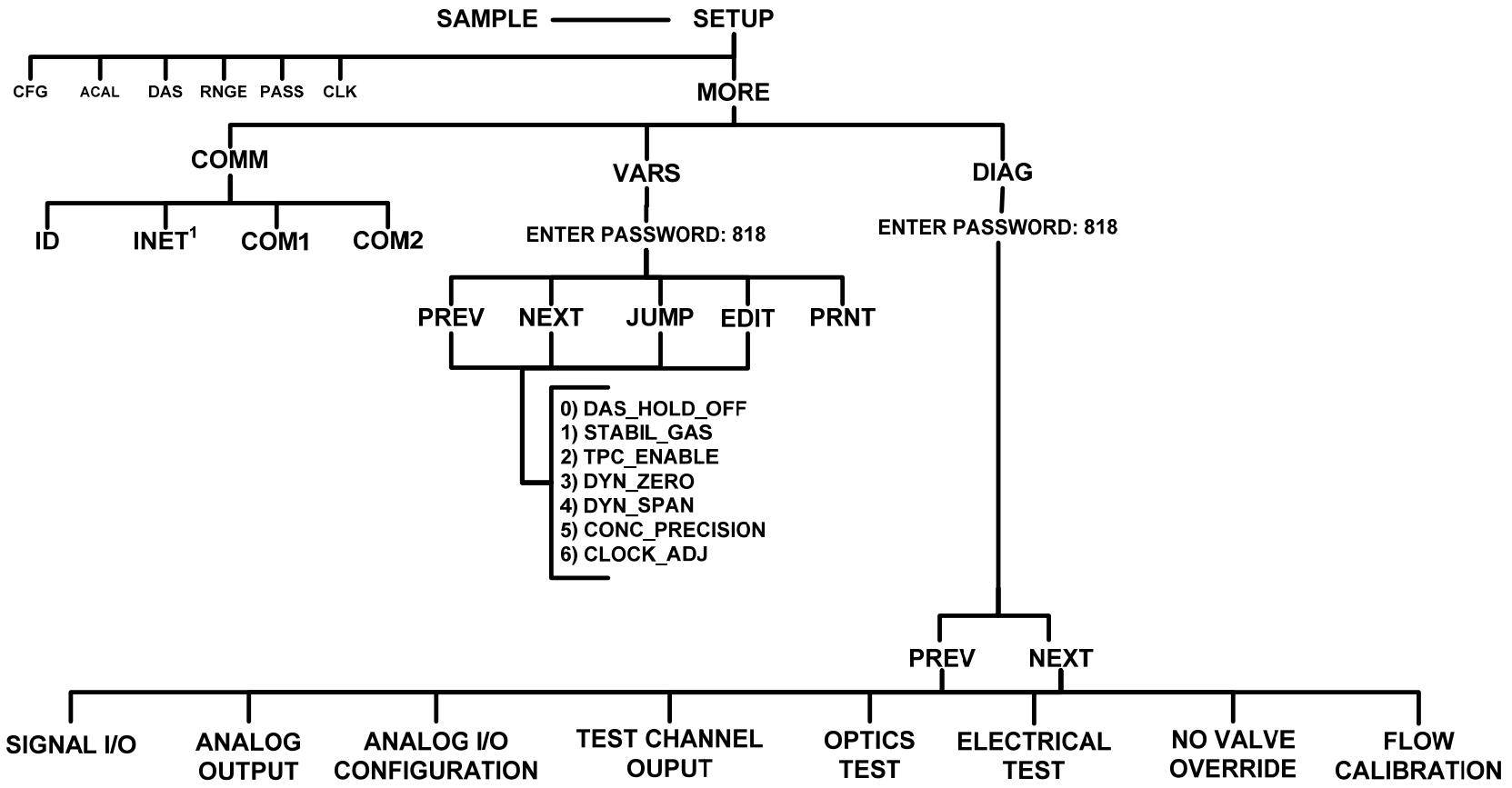
APPENDIX A-1: Software Menu Trees: the Sample Menu



[1] Only appears when warning messages are active.
[2] Appears only if AUTO RANGE mode is activated.
[3] Only appears if analyzer is equipped with Calibration Valves.



[1] E-Series models: Only appears if optional Ethernet PCA is installed.
NOTE: When Ethernet PCA is present in E-Series models, COM2 submenu disappears.

For all other menus, refer to main manual for your model (T265: T200 or Model 265E: M200E).