OWNER'S MANUAL

Model CGA-801
Combustion Gas Monitor

ALNOR®
TSI Incorporated

Part Number
1980508 / Revision A / August 2004

Address
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LIMITATION OF WARRANTY AND LIABILITY (effective July 2000)
Seller warrants the goods sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for twenty-four (24) months, or the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions:

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b. Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment.

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Service Policy
Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call Customer Service at (651) 490-2707 or (800) 861-7897.

CONTENTS

Chapters

Appendixes

Introduction

Manual Purpose

This manual describes the operation and maintenance of your Alnor CGA-801 Combustion Analyzer Monitor.

Using This Manual

Before using the CGA-801 monitor for the first time, review this manual in its entirety.

Warnings and Cautions

The manual assumes that you have a basic understanding of combustion safety concerns and are thoroughly familiar with the fuel burning equipment being tested. If you are using measurements as the basis for equipment adjustments, rely on your good judgment and experience together with the measured data. This is especially important where safety issues are of concern. Equipment adjustments must always coincide with the fuel burning equipment manufacturer's recommendations.

W A R N I N G
High temperatures and toxic gases are produced when fossil fuels are burned. Only qualified individuals, thoroughly familiar with operating and adjusting fuel-burning equipment, should use gas measurements for the purpose of making equipment adjustments.

W A R N I N G
The CGA-801 is not intended for use as a continuous monitor.

Chapter 1

Instrument Description

The CGA-801 Combustion Gas Monitor is a portable instrument designed for measuring key gases associated with the combustion of fossil fuels. The CGA-801 monitor is typically used to evaluate the performance of boilers, furnaces, and hot water tanks, and determine the presence of toxic pollutants for regulatory and safety concerns.

All instruments use electrochemical gas sensors, which for most models provide two or three years of useful service before sensor replacement is necessary. Sensor replacement is easily performed by the operator.

The CGA-801 monitor is supplied with a sampling probe consisting of a stainless sample tube, plastic handle, rubber or non-reactive plastic sample line (for NO_2, SO_2), and in-line water-stop filter. The sampling probe is used to draw the gas sample at a rate of 0.8 liters per minute from the sampling point to the sensor in the instrument. The sample flow is provided by an internal diaphragm vacuum pump.

Chapter 2

Unpacking

Carefully unpack your CGA-801 Combustion Gas Monitor and accessories from the carrying case. Check the individual parts against the list of components in the table below. If items are missing or damaged, notify TSI immediately.

List of Standard Components

Qty.	Item Component	Part/Model
1	CGA-801 Combustion Gas Monitor	
1	Sample probe with water-stop filter	801993
4	AA cell alkaline batteries	
1	Owner's manual	1980508

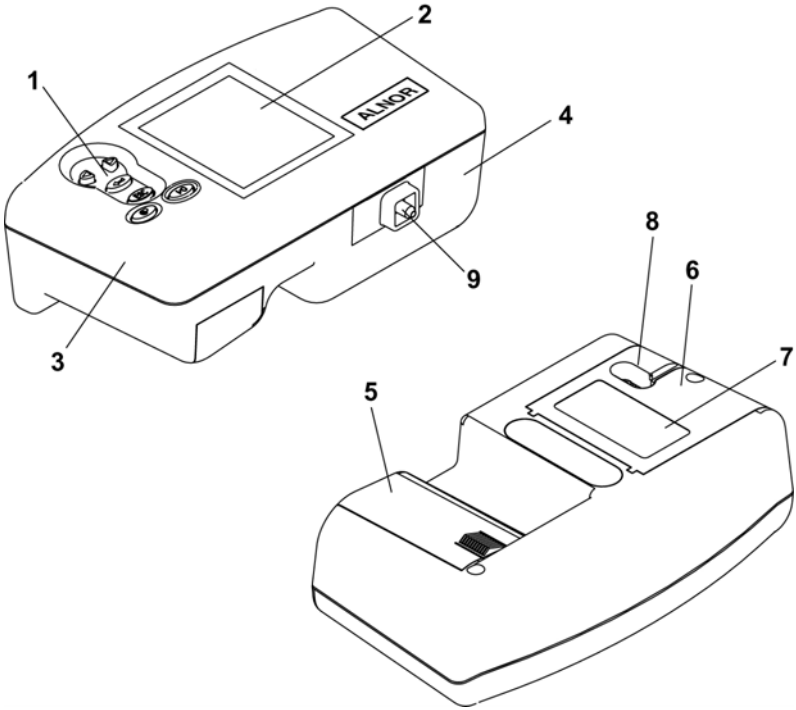
Accessories and Replacement Parts

Item	Part/Model	For Model
Boot with magnet and carrying strap	801995	All
Water-stop filter replacement kit	801922	All
Optional Water trap	802215	All
Water trap filters for optional Water Trap	1602309	All
CO replacement sensor	802006	CGA-801
Replacement pump	801996	All
CO sensor calibration kit, 500 ppm CO	801999	CGA-801

Chapter 3

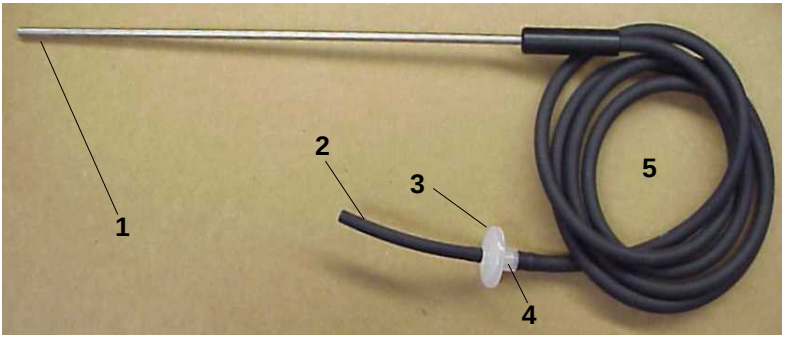
Component Identification

Key components of the CA-CALC™ Single Gas Monitor and sampling probe are identified in Figures 1 and 2 and under section headings in the text that follows.



1. Buttons
2. Display
3. Top cover
4. Case bottom
5. Battery cover
6. Sensor cover
7. Instrument label
8. Gas vent
9. Sample port

Figure 1: CGA-801 Combustion Gas Monitor



Sampling Probe for CGA-801

1. Stainless steel sampling tube
2. Connection tubing
3. Water-stop filter
4. Tube fitting
5. Rubber sampling tube

Figure 2: CGA-801 Sampling Probe Components

The Gas Sensors

Your CGA-801 monitor uses electrochemical gas sensors for making gas measurements. Electrochemical sensors operate by oxidizing or reducing molecules of the measured gas contacting the sensor's *sensing electrode.* A sensor current develops which is proportional to the reaction rate. The current is detected by the CGA-801 electronics and converted to a gas concentration reading proportional to the current. Gas concentration is displayed in units of PPM or standard mg/m^3, or for oxygen (O_2), displayed as a percent.

The Sampling Probe

The sampling probe consists of a stainless steel probe tip, plastic handle, sampling tube and water-stop filter.

Diaphragm Pump

The CGA-801 monitor samples exhaust gases from the flue and delivers them to the electrochemical sensors using a diaphragm sampling pump. The pump is accessed through the sensor cover (see Figure 1), and can be removed for cleaning or for replacement. Typical pump life is 1000 hours.

Water-Stop Filter

Your sample probe is provided with a small, water-impermeable *hydrophobic* filter. This filter protects the pump and gas sensor from water (and soot), which can adversely affect instrument performance. When water is present, the filter plugs, causing the instrument flow to cease. Where water or contamination are present (flue measurements), it is recommended that you purchase a Model 802215 Water Trap. This item is described below.

Optional Model 802215 Water Trap

The Model 802215 Water Trap, shown in Figure 2, is used to remove moisture that collects in the sample tubing when combustion gases are sampled from the flue. The water trap uses two chambers and a filter to maximize water and particulate removal. Unlike the water-stop filter provided standard, the Water Trap enables extended sampling from a moist, dirty air stream.

Optional Protective Boot Model 801995

An optional protective boot is available for your instrument. The boot provides drop protection for the instrument and is supplied with a magnet, enabling the instrument to be mounted on a flat, vertical metal surface. The boot is equipped with a carrying strap.

Chapter 4

Getting Started

Installing Batteries

The CGA-801 Combustion Gas Monitor operates using four AA batteries enabling the instrument to operate for approximately 10 hours with the pump running.

To install the batteries turn the Combustion Gas Monitor over and remove the battery cover by pushing down on the cover latch tab with your thumb and sliding back, away from the instrument case. Turn the instrument over and shake, allowing the battery holder and batteries to fall out into your hand. Note the orientation of the contacts on the holder and in the instrument.

Replace the used batteries with new batteries, matching the + and – terminals, as indicated on the battery holder. Note the location of the battery contacts. Replace the holder by inserting it straight down into the battery compartment

Assembling the Sampling Probe

Refer to the photographs in Figure 2. Your probe comes assembled as shown. Should the water-stop filter become separated, reconnect it by attaching the short black rubber tube ($\frac{1}{8}$" ID) to the smooth "Lure" fitting. Connect the larger black rubber tube ($\frac{3}{16}$" ID) to the barbed tube fitting attached to the water-stop filter. Where the transparent polypropylene tubing is supplied (probes for NO_2 and SO_2), reconnect the poly-tubing by sliding it into the rubber tubing as shown in the photos.

Chapter 5

Basic Operation

Buttons and Button Operations

	**ON-OFF** Control Button Turns the instrument **on** and **off**.
	The **ENTER** Control Button Press the **ENTER** button to execute a command, such as selecting a menu item.
	The **ESC** Control Button Used to return to the previous menu or cancel a process.
	**ARROW** Control Buttons Use the arrow buttons to step between items and change values.
	The **PUMP** On-Off Button Turns the pump on or off.

Startup

Remove the sampling probe from the flue or disconnect the sample tubing from the sampling port. Press the ON-OFF button. Figure 3 diagrams the start-up sequence and shows screens displayed during startup. If no errors are detected, the Data Display screen appears when the sequence is complete.

While the WARM screen is displayed, the O_2 sensor is calibrated using ambient air, and other gas sensors are zeroed.

Connecting the Sampling Probe

The sampling probe is connected to the instrument by pushing the short rubber sample tube completely over the instrument sample port.

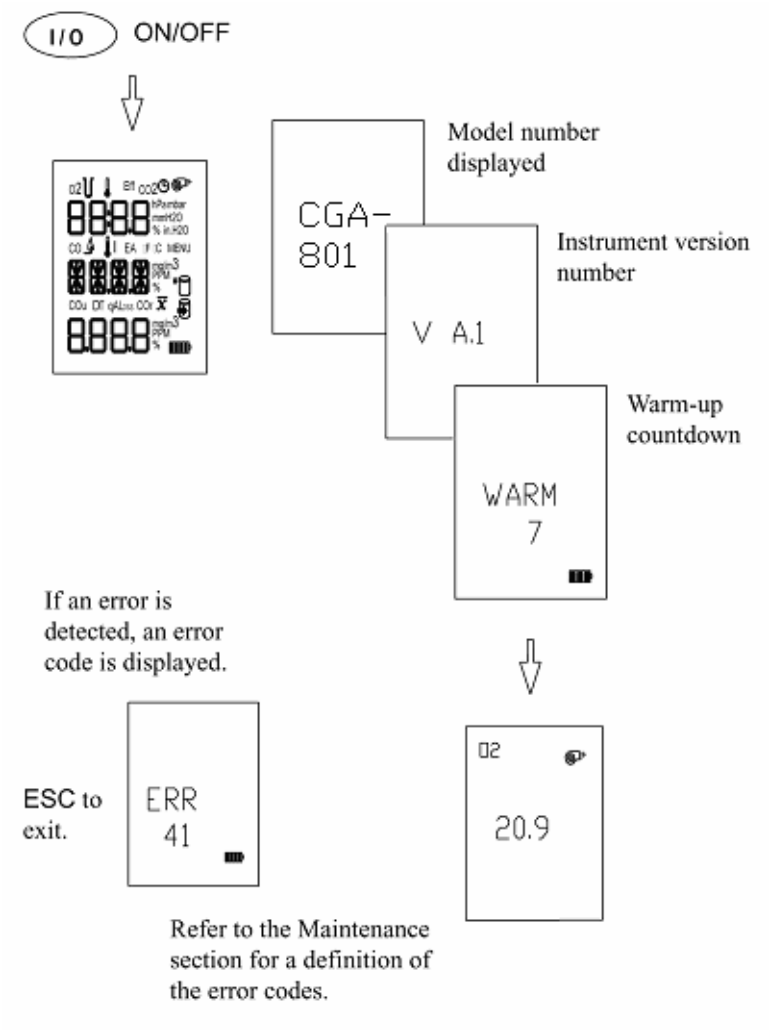


Figure 3. Startup Sequence

Data Display, Viewing the Gas Measurement

Measurements and calculations are presented in the Data Display screen. The Data Display appears once the Startup sequence is complete. Refer to the section below for instructions on changing the units of measurement.

Changing the Gas Measurement Units

Units of gas concentration are changeable. Parts per million, PPM, or milligrams per *standard* cubic meters, mg/m^3 can be presented on your

instrument Data Display. ***Note:*** *mg/m^3 is referenced to 0 deg. C and 760 mm Hg.*

To change units, press the ENTER button. Use the ARROW buttons to and scroll to UNITS. Press ENTER. Select either PPM or mg/m3. Press ENTER. The figure below outlines steps for changing units.

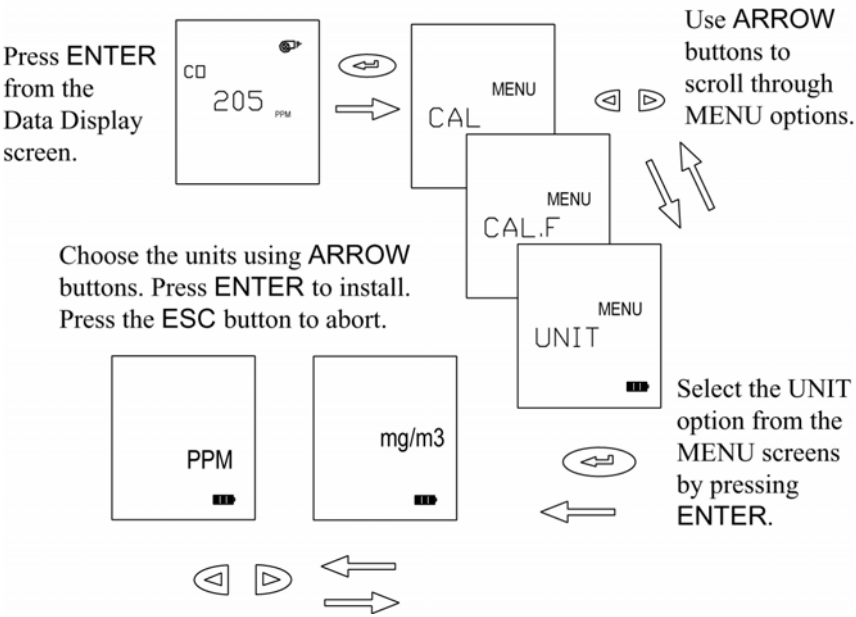


Figure 4. Choosing Display Units

Making Gas Measurements

Your instrument is ergonomically designed to be held in the left hand. The sampling probe is held in the right, or may be mounted. If you have the protective boot option Model 801995, an attached magnet enables the instrument to be mounted vertically to the metal side of your appliance, for hands-free operation.

Measurement Interval

When making gas measurements, keep the measurements short. Although the instrument is capable of measurements lasting many minutes, the gas sensors are designed for discrete sampling applications. When high gas concentrations are measured for extended periods, chemical filters in the sensor are used up prematurely. The chemical filters remove *interfering* gases that can cause false readings, influencing the accuracy and lifetime of the sensor. In addition, soot and

moisture will plug the water-stop filter, reducing or stopping the gas flow.

***Note**: To reduce sensor exposure to gas and to reduce build up of water vapor in the sampling lines and water trap, turn the pump off when not making measurements.*

Operating Temperature

Best results are obtained if the CGA-801 monitor is allowed to stabilize at the temperature of the test environment before using.

Plugged Water-Stop Filter

A significant change in the sound of the pump may indicate a plugged water-stop filter. If plugging is suspected, refer to the appropriate heading in the Maintenance section of this manual.

High Temperature Measurements

When sampling from high temperature, leave at least four inches between the plastic handle of the probe and the outside edge of the flue. The stainless-steel sampling probe is a poor heat conductor, and following the four-inch rule above, temperatures as high as 700 degrees centigrade (1290ºF) can be measured without damaging the probe handle.

Chapter 6

Gas Sensor Calibrations

Calibration Equipment Setups

Gas sensors can be calibrated periodically to maintain the best accuracy. Gas sensors do drift over time, depending upon the operating environment and gas sensor's exposure history.

With the proper equipment, such as that shown in Figures 5 and 6 below, it is easy to calibrate your CA-CALC gas sensor. If you wish, you may also return your instrument to TSI for a new *factory* calibration, or purchase a new factory calibrated sensor.

The equipment needed to calibrate individual gas sensors can be purchased from TSI as calibration kits, or you may elect to put together your own calibration system. Model numbers for Alnor sensor calibration kits are found in Chapter 2, "Unpacking." Two calibration setups are presented in Figures 5 and 6. A brief discussion of these calibration setups is presented in the following section.

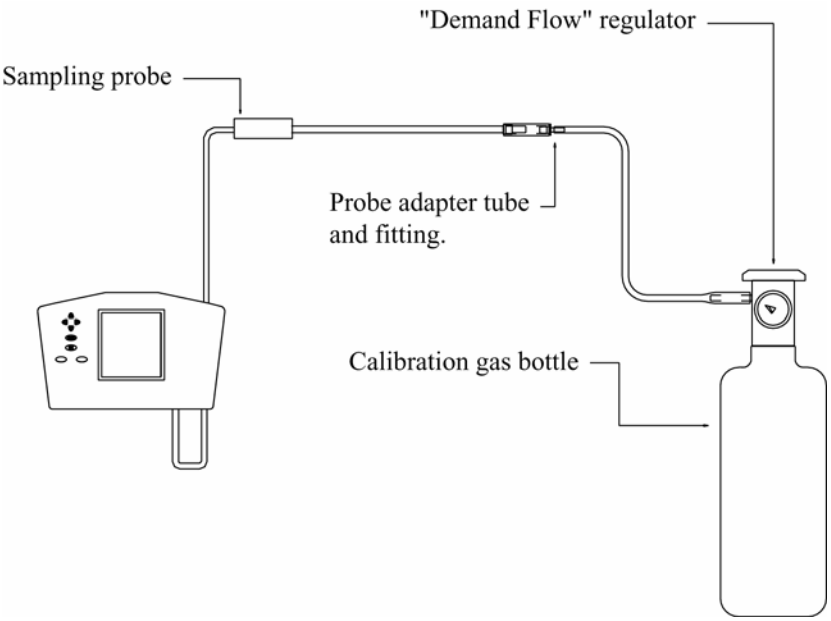


Figure 5. Calibration with Alnor Calibration Kit

A TSI supplied calibration kit (Figure 5) uses a *Demand Flow* regulator to supply gas to the CGA-801 monitor in response to the draw of the instrument sampling the pump. If a conventional regulator and valve are used (Figure 6), the setup supplies gas to the instrument using a tee to a vent extra gas. This prevents a forced flow at the instrument inlet. The bead-type flow meter depicted in the figure is used to verify there is extra flow (.5 to 2 L/min recommended). Extra flow is required to prevent room air from being drawn in, diluting the sample.

Once you have the assembled the appropriate hardware described, follow the steps in the next section to perform the gas sensor calibration.

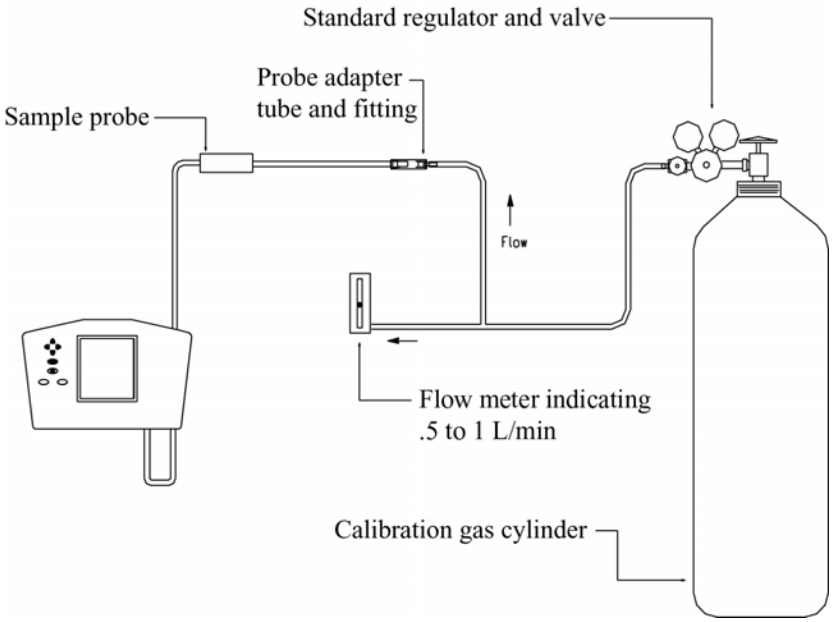


Figure 6. Alternative Calibration Setup

CAL MENU Option, Sensor Calibration

The CAL option is used for performing calibration of the gas sensor. A schematic showing the button operations and screen displays for sensor calibration is shown in Figure 7. The calibration procedures are also described below.

1. To begin, press the ENTER button from the Data Display screen. The CAL screen appears. CAL is one of three MENU options selectable using the ARROW buttons (reference Figure 4).
2. Press the ENTER button when CAL is displayed. The word ZERO indicates that the sensor voltage is first read, without calibration gas.
3. Press ENTER to start the ZERO calibration. Wait for the countdown to finish.
4. When the zero calibration is complete, SPAN is indicated on the display. SPAN indicates that the voltage will be measured in the presence of your calibration gas.
5. Connect your calibration gas to the sampling probe as shown in Figures 5 and 6 described earlier.
6. Use the ARROW keys to adjust the SPAN value to match that of your calibration gas.
7. Press ENTER to start the SPAN calibration. Wait for the countdown to complete.
8. If an error code appears, the initial calibration value will be reinstalled. Refer to Appendix A.

***Notes**: ■ Pressing the ESC button will bypass either the ZERO or SPAN calibration.*

■ *When the calibration is complete, the calibration factor automatically changes to reflect the new calibration. For more on the calibration factor refer to the CAL.F section in the Maintenance chapter.*

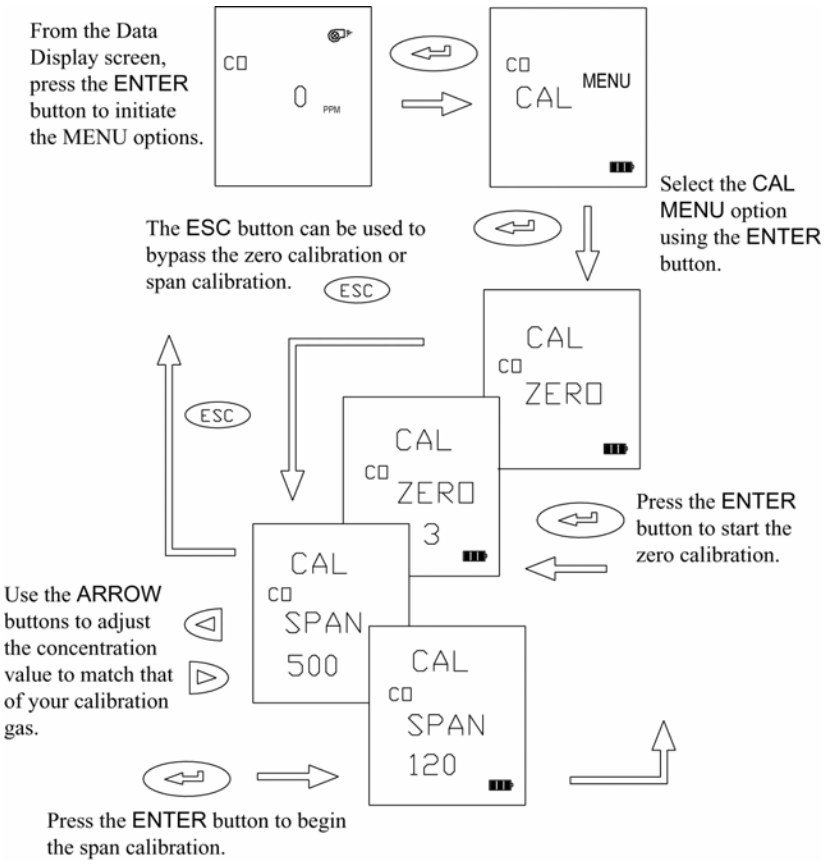


Figure 7. Gas Calibration Button Sequence

Chapter 7

Maintenance and Troubleshooting

Water-Stop Filter Plugging

When water comes in contact with the water-stop filter (Figure 2), it reduces or stops flow to the gas sensor. If this occurs, the filter needs to be dried out or replaced.

Check for a plugged flow by blocking the end of the probe with your thumb. Listen for a lowering of the pump frequency. If no change in tone occurs, your filter is probably already plugged. Disconnect the sampling probe from the instrument. The pump sound should change, increasing in frequency. Change the filter, setting the plugged filter aside to dry. If filter plugging is a continuing problem, a TSI Model 892215 Water Trap is recommended.

Changing the Water-Stop Filter

1. Refer to Figure 2.
2. Remove the sample tubing from the instrument sample port.
3. Remove this tubing from the filter and save.
4. Twist the fitting on the end of the filter counterclockwise to separate the filter from the fitting. Set the filter aside to dry, or discard if clearly dirty.
5. Replace with a new filter. Connect the fitting and replacing the short tubing.

Cleaning the Sample Probe

Cleaning may be necessary in high-soot environments. Soot accumulates in the steel sampling tube and sampling line and over time may contribute to a blocked flow path. It is assumed that an optional water trap is present. The Water-stop filter supplied standard will not perform in environments where high levels of particulate material (soot) are present.

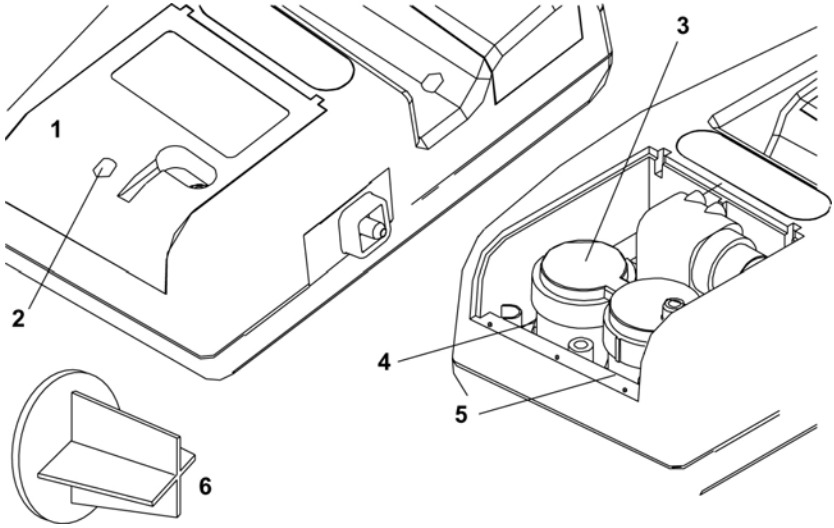
1. Disconnect the sampling probe from the instrument.
2. Remove the water-stop filter or remove the optional Water Trap (if installed) by separating the sample tube from the tube stub on each end of the trap.
3. Rinse the tubing, allowing the water to drain from the probe end. When the water is clear, discontinue the rinse. Orient the probe and tubing so excess water drains from the sample lines.

4. Allow adequate time for the interior of the probe to dry. Replace the water trap making sure the water trap is oriented properly. The filter must be toward the instrument.

Adding or Replacing a Gas Sensor

Changing the CO Sensor

1. Remove the sensor cover shown in Figure 9, by removing the sensor cover screw (2).
2. Carefully lift the rubber sensor manifold (3) from the sensor and bend it back. *Do **not*** attempt to remove the rubber manifold from the case!
3. Pull the sensor, together with the foam gasket, out of the instrument.
4. Remove the gasket from the sensor.
5. Replace the gasket in the rubber sensor manifold (3) by aligning the notch in the gasket with the tab on the manifold (7).
6. Install the new sensor by aligning the pins on the sensor with those on the instrument electronics board.
7. Replace the sensor manifold, pushing the foam gasket over the new CO sensor until it is fully seated. Replace the sensor cover and cover screw.
8. Find your calibration factor sheet included with your new sensor. Enter the new calibration factor as described in the section “CAL.F MENU Option” later in this chapter.



1. Sensor Cover
2. Sensor retaining screw
3. Rubber sensor manifold
4. CO sensors
5. Dummy sensor plug
6. Manifold Tab for CO gasket alignment

Figure 9. Removing and Replacing a Gas Sensor

CAL.F MENU Option—Setting the Calibration Factor for a New Sensor

When you install a calibrated replacement sensor from TSI, you must complete the new sensor installation by entering a new calibration factor. This factor is determined by a sensor calibration at the factory.

After installing your new sensor, find the *calibration factor* sheet.

Use the MENU option CAL.F, and enter calibration factor provided. Refer to the details outlined in the schematic below.

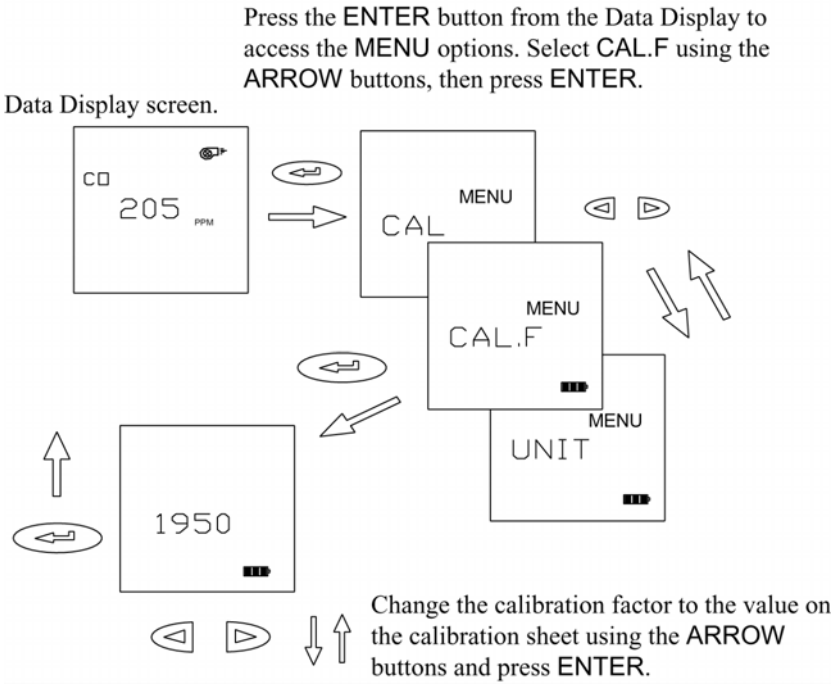


Figure 10. Setting the Calibration Factor

Appendix A

Error Codes Defined

Error code by number:

9. Can't save data to EEPROM.
12. Model number checksum error.
16. A/D calibration checksum error.
17. Chem sensor checksum error.
31. CO zero voltage out of range.
36. Instrument temperature out of range.
38. A/D converter calibration factor out of range.
39. A/D converter offset factor out of range.
41. CO gain factor out of range.
70. Internal program error—contact TSI.

Appendix B

CGA-801 Combustion Gas Monitor Detailed Specifications*

Carbon Monoxide (CO)
Range: .....0–2000 ppm (9999 ppm max)
Accuracy: .....0–100 ±5 ppm or 10% of reading
100–1000 ±10 ppm or 5% (greater of)
Resolution: .....1 ppm
Response Time: .....<30 seconds to 90% of step change

External dimensions: .....4 x 7 x 2¼" (10 x 18 x 5.7 cm)

Weight: .....*1.2* lbs

Power Requirements:
Batteries: .....4 AA cell alkaline batteries
Battery life: .....>12 hours (pump on)

Note: *These specifications assume the instrument is allowed to stabilize at the operating temperature before being turned on.*

*Specifications are subject to change without notice.

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