

Model 8750

***COMBUCHECK™
Single Gas Monitor***

***Operation and Service
Manual***

*August 2000
P/N 1980338 Rev: B*

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Single Gas Monitor

*Operation and Service
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Buyer and all users are deemed to have accepted this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended, modified or its terms waived, except by writing signed by an Officer of Seller.

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 TSI's Customer Service department at (800) 777-8356 (USA) and (1) 651 490-2711 (International).

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Chapter 1

Unpacking and Parts Identification

Carefully unpack the instrument and accessories from the shipping container. Check the individual parts against the list of components in Table 1-1. If anything is missing or damaged, notify TSI or your local distributor immediately.

Table 1-1: List of components

Qty	Item Description	Part/Model
1	Model 8750 COMBUCHECK with Probe and Sensor	8750
1	Carrying Case	1319114
4	AA Alkaline Batteries	1208013
1	Operation and Service Manual	1980338
1	Certificate of calibration	-----

Parts Identification

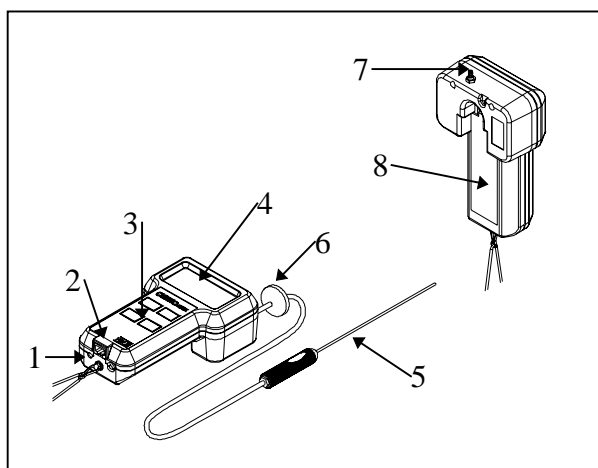


Figure 1-1: COMBUCHECK

- | | |
|------------------------|-------------------------|
| 1. AC Adapter Port | 5. Sampling Probe |
| 2. Printer Output Port | 6. Hydrophobic Filter |
| 3. Keypad | 7. Sample Port |
| 4. Display | 8. Battery Access Cover |

Replacement Parts and Accessories

For replacement parts or accessories, please see Tables 1-2 and 1-3.
Contact TSI or your local distributor to place an order.

Table 1-2: Replacement parts

Item Description	Part/Model
Hydrophobic Filter Kit (includes 5 filters)	801922
Probe Kit (5 ft (1.5 m) tubing, in-line filter, sample probe)	801924
Sample Tubing Kit (includes five 5 ft. (1.5 m) sample tubes)	801925
Liquid Trap Replacement Filter Kit (includes 20 filters)	801935
Carbon Monoxide (CO) sensor	801387
Sulfur Dioxide (SO ₂) sensor	801388
Nitric Oxide (NO) sensor	801389
Nitrogen Dioxide (NO ₂) sensor	801390
Oxygen (O ₂) sensor	801392
3V Lithium Battery	Sanyo CR14250SE or equivalent

Table 1-3: Accessories

Item Description	Part/Model
AC Adapter	120 V, NEMA-5 2613033
	230 V, European, CEE 7/16 2613078
	230 V, Great Britain 800169
	240 V, Australian 2613106
Liquid Trap	801921
Carbon Monoxide Calibration Kit - 200 PPM CO, 0 PPM gas (air)	801933
Sulfur Dioxide Calibration Kit - 200 PPM SO ₂ , 0 PPM gas (air)	801926
Nitric Oxide Calibration Kit - 200 PPM NO, 0 PPM gas (air)	801927
Nitrogen Dioxide Calibration Kit - 25 PPM NO ₂ , 0 PPM gas (air)	801928
Oxygen Calibration Kit - 0 PPM gas (N ₂), Span gas (20.9% O ₂)	801934
Calibration Gas, 200 PPM CO (in air), 103 Liters	801074
Calibration Gas, 200 PPM SO ₂ (in air), 58 Liters	801929
Calibration Gas, 200 PPM NO (in N ₂), 58 Liters	801930
Calibration Gas, 200 PPM NO ₂ (in air), 58 Liters	801931
Calibration Gas, air, 103 Liters	801077
Calibration Gas, Nitrogen, 103 Liters	801056
Demand Flow Regulator	801932

Chapter 2

Set Up

Supplying Power

The COMBUCHECK can be powered in one of two ways: using four size AA batteries or the optional AC Adapter.

Installing the batteries

Remove the battery cover (Figure 1-1) and insert four size AA batteries as indicated by the diagram located on the inside of the battery compartment. TSI ships the unit with alkaline batteries. The COMBUCHECK is designed to operate with either alkaline or NiCd rechargeable batteries. Carbon-zinc batteries are not recommended because of the danger of battery acid leakage. Typical battery life with the display back light on at 20°C is 12 hours for alkaline batteries or 6 hours for NiCd batteries. Not using the display back light will increase battery life to 24 hours for alkaline batteries.

Using the Optional AC Adapter

The optional AC adapter allows you to power the COMBUCHECK from an electrical outlet. When using the AC adapter, the batteries (if installed) will be bypassed. The AC adapter is not a battery charger.

Connecting to the Optional Model 8925 Portable Printer

To connect the Model 8925 printer to the COMBUCHECK, locate the Printer Interface Cable (supplied with the optional printer) and connect the 9-pin end labeled "PRINTER" to the printer and the other end to the data port of the COMBUCHECK. If the printer is on when the COMBUCHECK is turned on, the instrument model number, serial number, sensor type, and revision level are printed.




Caution: This symbol is used to indicate that the data port of the COMBUCHECK is not intended for connection to a public telecommunications network. Connect the data port only to another RS232 port.

Chapter 3

Operation

NOTE: Before performing any function of the COMBUCHECK, please read the entire manual carefully so that you are prepared to use the instrument correctly and will have all that is necessary to perform a specific operation.

Overview

The COMBUCHECK measures CO, SO₂, NO, NO₂ or O₂ gas concentrations, depending on which sensor is installed. When the instrument is first turned on, it will go through a power-up sequence where all displayable items appear briefly. The display will then show the approximate battery life remaining. The instrument will display the battery symbol  when the battery voltage becomes very low, indicating battery replacement is necessary. The instrument will turn off when the voltage becomes too low to operate correctly.

The instrument will automatically detect the type of sensor that is installed. If a calibration has not been performed on this sensor type, the instrument will automatically start a calibration cycle and prompt for the zero gas. For further instructions on the calibration procedure, see the *Calibrating the Sensor* section. Calibration can be bypassed by pressing either the LIGHT or PRINT key and default values that are programmed into the instrument will be used.

Operation With the O₂ Sensor

When an Oxygen (O₂) sensor is used, the instrument will automatically perform a span calibration using the surrounding air as the calibration gas (O₂ concentration of outside air is a very uniform 20.9% worldwide). This is completed each time the instrument is turned on and takes 20 seconds to complete. A countdown is performed during the O₂ calibration. To bypass the automatic calibration and use the last calibration, press the CALIBRATE, PRINT or LIGHT key any time during the 20 second countdown.

ON/OFF Key

Press this key to turn the instrument on and off.

CALIBRATE Key

This key is used in calibrating the specific sensor that is in the instrument. See the *Calibrating the Sensor* section for details on calibration.

PRINT (↑) Key

Press the PRINT key to print the information on the display to the optional Model 8925 portable printer. Press and hold the PRINT key to continuously print data to the printer.

LIGHT (↓) Key

This key turns on the display back light, making the display readable in areas with low lighting. Press the LIGHT key to turn on the light, press again to turn the light off. The instrument will always start with the light off.

Operating Instructions

To operate the instrument correctly, follow these steps:

1. Remove the battery cover and install 4 AA size batteries.
2. Connect the sample tubing with the hydrophobic filter and probe to the inlet fitting on the instrument. Do this before the instrument is turned on. *NOTE: Always use the instrument with the hydrophobic filter in the sample line. The hydrophobic filter prevents condensation from cooled combustion gas from contacting the sensor. If moisture is condensing in the sample tube, remove the probe from the sample and allow the moisture to evaporate. If long-term sampling in a moist environment is required, use of a liquid trap (TSI P/N 801921) is recommended.*
3. Turn the instrument on using the ON/OFF button. If the instrument has not been calibrated since the sensor has been installed, the instrument will automatically begin the calibration cycle. See the *Calibrating the Sensor* section for further details on the calibration procedure.

Sampling High Temperature Gas

Gas may be sampled continuously at temperatures as high as 540 °C (1000 °F). When sampling at high temperature, make sure four inches or more of the stainless steel sampling probe is exposed to room temperature (see Figure 3-1). This prevents damage to the probe handle and helps cool the gas.

Replacing the Sensor

To replace the sensor in the instrument, follow these steps:

1. Remove the battery cover from the back of the instrument.
2. Remove the batteries and unplug the AC adapter if connected.
3. Remove the five screws (two on back of case, three inside the battery compartment). Pull apart the case carefully and lay the two halves side by side (shown in Figure 3-2).

4. The sensor is located in the right hand corner of the top case (see Figure 3-2). Pull straight up to remove the sensor and replace it with the new sensor. The connector on the sensor is keyed so it only fits into the socket one direction; do not force it.
5. Replace the back cover and fasten screws. Re-install the batteries and battery cover.
6. Allow the sensor to stabilize for at least two hours before calibrating. The instrument can be off during this time.
7. Turn the instrument on. The instrument detects the sensor type automatically. Each time you remove or replace a sensor it needs to be calibrated, even if it was previously calibrated. Follow the instructions listed in the *Calibrating the Sensor* section.

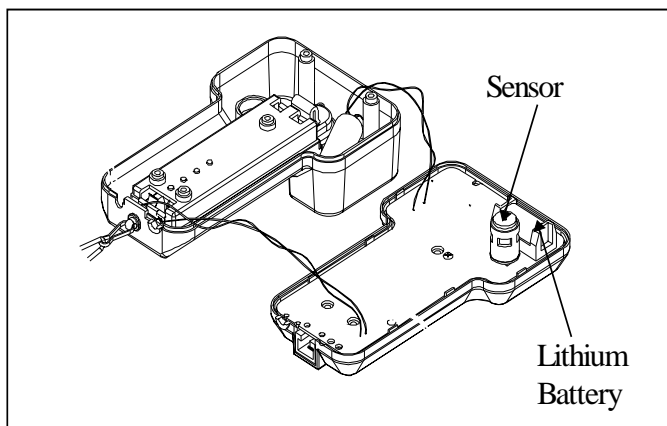


Figure 3-2: Replacing the Sensor or Lithium Battery

Replacing the Lithium Battery

When service code 2 is displayed, the lithium battery needs to be replaced. Typical battery life is 2 years, but will vary depending on the type of sensor that is used. To replace the battery follow these instructions:

1. Remove the battery cover from the back of the instrument.
2. Remove the batteries and unplug the AC adapter if connected.
3. Remove the five screws (two on back of case, three inside the battery compartment). Pull apart the case carefully and lay the two halves side by side (shown in Figure 3-2).
4. After removing the cover from the lithium battery, remove the lithium battery (see Figure 3-2) by lifting lightly on the clip and pulling out the battery. Replace with a new battery, making sure to note the polarity markings on the battery holder. Replace the battery clip and cover.

5. Replace the instrument back cover and fasten the screws. Re-install the batteries and battery cover.
6. Allow the sensor to stabilize with the new battery for two hours. The instrument can be turned off during this time.

Calibrating the COMBUCHECK With a CO, NO, NO₂ or SO₂ Sensor

Each time a sensor is placed in the COMBUCHECK it needs to be calibrated. For information on calibration gas kits available from TSI, see Table 1-3. To calibrate the sensors, follow the steps outlined below.

1. Before beginning calibration, the new sensor must be allowed to stabilize in the instrument for at least two hours. The instrument can be off during this time.
2. Press and hold the CALIBRATE key to begin the calibration procedure. The display will begin a countdown from five to zero. When the display reads zero, release the key immediately. If the key is released too soon or too late, the instrument will go back to normal sampling.
3. ZERO will appear on the display prompting the user to attach the zero calibration gas.
4. Install the demand flow regulator on the zero calibration gas tank and connect tubing from the regulator to the inlet fitting on the COMBUCHECK. *NOTE: The zero calibration can be performed using room air for all sensors except O₂. This means that no zero calibration gas bottle is needed. When using room air for the zero calibration, you must be confident that no combustion gas is present to give a false zero. For example, a boiler room or loading dock would be a bad place for a zero calibration due to the possible presence of combustion gases.*
5. Press and release the CALIBRATE key to begin a zero reading. The COMBUCHECK begins a 90 second countdown during the zero reading. The actual zero reading is taken in the last 10 seconds. When the countdown is completed, the display indicates SPAN and the span concentration.
6. Install the demand flow regulator on the span calibration gas cylinder. Use the ↑↓ arrow keys to adjust the concentration displayed on the COMBUCHECK to match the concentration on the span gas cylinder.
7. Press and release the CALIBRATE key to take a span gas reading. The COMBUCHECK starts a 90 second countdown. When the countdown reaches zero, the instrument returns to the normal measurement mode.
8. With the gas still connected, observe the reading on the display, it should indicate the span gas concentration. If not, repeat the calibration.

9. If the displayed reading is accurate, remove the regulator and tubing. The calibration is now complete.

NOTE: *If “Service 5” message appears, a calibration error has occurred. Calibration will need to be performed again.*

Calibrating the COMBUCHECK With an O₂ Sensor

Span Calibration

When an Oxygen (O₂) sensor is used, the instrument automatically performs a calibration using the surrounding air for the span gas. This is completed each time the instrument is turned on and takes 20 seconds to complete. A countdown is performed during the O₂ calibration. To bypass the automatic calibration and use the previously stored calibration, press the CALIBRATE, PRINT or LIGHT key any time during the 20 second countdown.

A 90 second span calibration can be performed by pressing the CALIBRATE key immediately following the zero calibration described below. This span calibration is used when the calibration gas is obtained from a bottle and not from the surrounding air.

Zero Calibration

The O₂ sensor may be re-zeroed if high accuracy is required at low O₂ concentrations. To re-zero the O₂ sensor, a bottle of N₂ calibration gas is needed, free of all O₂.

1. Press and hold the CALIBRATE key to begin the calibration procedure. The display will begin a countdown from five to zero. When the display reads zero, release the key immediately. If the key is released too soon or too late, the instrument will go back to normal sampling.
2. When ZERO appears on the display, connect the instrument to the source N₂ gas bottle with a demand flow regulator, or gas sample bag with pure N₂.
3. Press the CALIBRATE key to start the zero calibration. 90 seconds is required to complete the test. Once the zero calibration is complete, disconnect the N₂ calibration gas and either perform the optional span calibration by pressing the CALIBRATE key or turn the instrument OFF to bypass the span calibration.

Re-Zeroing the COMBUCHECK

The COMBUCHECK can be re-zeroed without performing a span calibration. If the COMBUCHECK reads a negative value, an incorrect zero calibration or

sensor baseline drift is indicated. Sensors can also drift positive. Before re-zeroing, you must be confident no combustion gas is present. A drift in the zero baseline reading does not indicate that a new span calibration is needed.

Re-zero the COMBUCHECK using the following procedure.

1. Follow steps 1 through 5 in the section above entitled, “**Calibrating the COMBUCHECK With a CO, NO, NO₂ or SO₂ Sensor.**”
2. Once step 5 is complete, turn the instrument OFF.
3. Turn the COMBUCHECK ON to verify the corrected zero.

Chapter 4

Maintenance

The COMBUCHECK requires very little maintenance to keep it performing properly.

Recalibration and Maintenance

To maintain a high degree of reliability in your measurements, we recommend that you return the instrument to TSI for annual factory calibration. For a nominal fee, we will quickly check the instrument for proper operation, calibrate the unit, and return it to you with a Certificate of Calibration and NIST traceability. This “annual checkup” helps ensure that the COMBUCHECK is always in good working condition; it is especially important in applications where strict calibration records must be maintained.

User Calibration

Periodic calibration of the COMBUCHECK will maintain maximum instrument accuracy. Calibration gas is readily available from TSI or another supplier. Make sure your supplier states the gas concentration accuracy specification.

During calibration, the instrument must draw the calibration gas in passively. Gas should not be forced into the inlet under pressure. TSI provides calibration gas in portable cylinders and ‘demand-flow regulators’ for calibration of the COMBUCHECK. Refer to Table 1-3 earlier in this manual for a complete list of calibration accessories. With the demand-flow regulator, gas is sampled as needed directly from the high pressure calibration bottle. A 58 liter calibration bottle can provide forty or more calibrations. If a gas bottle is used with a conventional regulator, gas must first be transferred to a sample bag (available from scientific supply houses). Sampling is then done from the bag.

Cases

If the instrument case or storage case needs cleaning, wipe it off with a soft cloth and soap and water. Never immerse the COMBUCHECK in water.

Storage

When storing the COMBUCHECK for more than a month, removing the batteries is recommended. This prevents damage due to battery leakage.

Hydrophobic Filter Replacement

The hydrophobic filter may plug with water or particulates and reduce or stop the pump flow. Refer to the *Maintaining and Verifying the Instrument Flow* section for additional information. Replacement filters can be purchased from the factory (see Table 1-2 for part numbers).

Sensor Replacement

The average life of the electrochemical sensors is approximately 2 years. Replacement sensors can be purchased from TSI or your local distributor and then field installed and calibrated (see Table 1-2 for part numbers). If you begin seeing the “Service 5” message appear repeatedly and calibration gases are correct, or if calibration is becoming necessary more often, it may be time to replace the sensor.

Maintaining and Verifying the Instrument Flow

Gas is drawn through the sample probe, hydrophobic filter and sample tubing, then pumped to the electrochemical gas sensor by a diaphragm vacuum pump. Reduced flow or no flow results when the in-line hydrophobic filter disk becomes loaded with particles or contaminated with water. Plugging with particles usually occurs over a long period of time, plugging with water can occur very quickly if the gas sample has a high moisture content.

The COMBUCHECK has a built-in self check for pump flow, however it has some limitations. Other methods to check flow in addition to the self-check are described below.

Condensed Water In the Sample Line

The sample flow stops when liquid water comes in contact with the hydrophobic filter. If using the in-line hydrophobic filter, keep a close eye on the sample line for evidence of condensed water vapor. Discontinue sampling if condensed surface moisture begins to stream or form drops on the interior surface of the sample tubing. Remove and dry the tubing if this occurs. If this happens often, we recommend purchasing the Model 801921 Liquid Trap for these sampling conditions.

Changes In the Pump Sound

An easy way to verify there is pump flow is to plug the end of the sample probe with your finger. You should hear a very noticeable drop in the frequency of the pump sound (lower tone). If the pump sound does not change, the hydrophobic filter needs to be replaced.

The “Service” Message

The COMBUCHECK automatically detects flow problems caused by a plugged hydrophobic filter by tracking the pump current. An initial check of pump current is performed by the instrument each time it is turned on. When the flow is restricted by a plugged filter during operation, an increase in the pump current is detected and the “Service” error message is displayed.

Limitations

False “Service” messages may result if the instrument is turned on before the sample line is connected. A large temperature change during operation may also cause a false “Service” message. No “Service” message will appear if the filter is already plugged when the instrument is turned on.

Chapter 5

Troubleshooting

Table 5-1 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the COMBUCHECK. If your symptom is not listed, or none of the solutions solves your problem, please contact TSI.

Table 5-1: Troubleshooting the COMBUCHECK

Symptom	Possible Causes	Corrective Action
No display	Unit not switched on	Switch on the unit
	Low or dead batteries	Replace the batteries or use optional AC adapter
	Dirty battery contacts	Clean the battery contacts
Unit beeps on power up and no display	Low or dead batteries	Replace the batteries or use optional AC adapter
Large negative readings	Corrupted calibration data	Recalibrate the sensor
	Contaminated sensor	Replace sensor
“Service” message*	High pump current	Checked for blocked tube
		Replace hydrophobic filter
“Service 1” message	No sensor is installed	Install sensor
	Loose sensor connections	Check sensor connections
“Service 2” message	Low lithium battery	Replace lithium battery
“Service 4” message	Memory loss or error	Recalibrate unit - Calibration can be completed by returning the unit to the factory or by field calibration
“Service 5” message	Calibration error	Check calibration gas and recalibrate sensor
		Replace the sensor
		Return to factory for service
Small negative readings	Sensor drift or zeroing in contaminated area	Re-zero instrument in clean air or use zero gas

* The pump “Service” message does not cause the pump to stop as do other service error messages. No service number is associated with this message.

Appendix A

Specifications

Specifications are subject to change without notice.

Carbon Monoxide (CO₂):

Sensor Type: Electrochemical
Range: 0-2000 PPM
Accuracy: $\pm 5\%$ of reading or ± 5 PPM, whichever is greater
Resolution: 1 PPM
Response Time: < 30 seconds to 90% of step change

Nitric Oxide (NO):

Sensor Type: Electrochemical
Range: 0-2000 PPM
Accuracy: $\pm 5\%$ of reading or ± 5 PPM, whichever is greater
Resolution: 1 PPM
Response Time: < 45 seconds to 90% of step change

Nitrogen Dioxide (NO₂):

Sensor Type: Electrochemical
Range: 0-100 PPM
Accuracy: $\pm 5\%$ of reading or ± 3 PPM, whichever is greater
Resolution: 0.1 PPM
Response Time: < 60 seconds to 90% of step change

Sulfur Dioxide (SO₂):

Sensor Type: Electrochemical
Range: 0-1000 PPM
Accuracy: $\pm 5\%$ of reading or ± 5 PPM, whichever is greater
Resolution: 1 PPM
Response Time: < 60 seconds to 90% of step change

Oxygen (O₂):

Sensor Type: Electrochemical
Range: 0-30 %
Accuracy: $\pm 0.5\%$
Resolution: 0.1 %
Response Time: < 30 seconds to 90% of step change

Instrument Operating Conditions:

Altitude up to 4000 meters
Relative humidity up to 80% RH, non-condensing
Pollution degree 1 in accordance with IEC 664
Transient over voltage category II

Instrument Temperature Range:

Operating Range: 32 to 122°F (0 to 50°C)
Storage Range: -40 to 140°F (-40 to 60°C)
Maximum Probe Temperature: 1000°F (540°C)

Instrument Humidity Range:

Continuous: 15 to 90 %
Intermittent: 0 to 99 %

Power Requirements:

Four AA-size batteries (included) or AC adapter (optional) 7.2 VDC, 300 mA, 4-18 watts (input voltage and frequency vary depending on which adapter is used)

Battery Life

(with alkaline batteries): 24 hours with display back light off
12 hours with display back light on

Backup Battery: 3 V Lithium

Backup Battery Life: 2 years

Pump:

Flow Rate: 0.75 l/min nominal

Physical:

External Dimensions: 4.0 in. x 6.6 in. x 1.5 in.
(102 mm x 168 mm x 38 mm)

Weight: 0.84 lbs (0.38 kg)

Display: Custom back lit LCD, 0.6 in. (15 mm) digit height

Meter Probe Dimensions:

Probe Length: 9.5 in. (241 mm)

Probe Diameter: 0.125 in. (3.2 mm)

Probe Type: Flexible stainless steel

Printer Interface:

Type: Serial

BAUD rate: 1200