

CO SERIES 2500

EXHAUST GAS ANALYZER

OPERATOR'S MANUAL

This manual provides instructions and precautions for proper and safe use of the CO Series 2500 Exhaust Gas Analyzer. The triangle symbol below is used throughout the manual to indicate important operating procedures and safety information.



CAUTION: Indicates a situation where possible damage to the test equipment or vehicle may occur if the correct procedures are not followed carefully.



WARNING: Indicates a hazard where personal injury may occur, how to avoid the hazard and the probable consequences of not avoiding the hazard.

PRECAUTIONARY INFORMATION

1. Carefully read this operator's manual before using the CO Series 2500 Exhaust Gas Analyzer.
2. To avoid personal injury and property damage, always observe the vehicle and equipment manufacturer's warnings, cautions and service procedures.
3. To prevent a shock hazard, do not expose test equipment to rain or wet conditions.
4. To prevent the risk of fire, do not expose test equipment to open containers of fuel or flammable vapors.
5. Always wear approved eye protection.
6. Keep yourself, clothing and equipment clear of all moving or hot engine parts.
7. Always use extreme care when working around components of the secondary ignition circuit, such as spark plugs and coil terminals.
8. Unless otherwise instructed, set the parking brake, place the gear selector in neutral or park and block the drive wheel(s).
9. Exhaust gas contains deadly poison. When testing a vehicle with the engine running, test in a well ventilated area or route the exhaust gas outside with an appropriate exhaust ventilation system.
10. Always unplug equipment from power sources when not in use.

SAVE THESE INSTRUCTIONS

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GETTING ACQUAINTED WITH THE OPERATOR'S MANUAL

This manual is designed to provide all of the information necessary to successfully operate the CO Series 2500. It is divided into two main areas:

General Information: Sections 1 and 2 describe the analyzer, assembly and basic operation of the equipment.

Maintenance: Sections 3, 4 and 5 show how to keep the analyzer running at its best. These sections include calibration procedures, troubleshooting, replacement parts and service information.

There are several ways to find information within this manual. When looking for a specific topic such as replacement filters, check the index at the back of the manual. If the topic is more general, for instance operator maintenance, look in the contents at the beginning of the manual.

TECHNICAL SUPPORT

For additional technical support or information not found in this manual, call Blanke Industries at 1-847-487-2780 or check our web site at www.blankeindustries.com. Our technical support is available during regular business hours, 8:00 AM to 5:00 PM (Central Time), Monday through Friday.

ABOUT THE CO SERIES 2500 EXHAUST GAS ANALYZER

The CO Series 2500 is designed to measure carbon monoxide (CO) emissions from the exhaust pipe of any internal combustion engine. This includes engines powered by gasoline, propane, natural gas and even diesel fuel. This portable analyzer is accurate, durable and easy to use.



Monitoring exhaust emissions is not only important to help control pollutants, it also helps maintain optimum fuel efficiency and extend engine life. This tool will let the operator quickly determine the general health of an engine. With the CO Series 2500, any engine can be properly tested and repaired to assure ideal engine performance.

UNPACKING THE ANALYZER

The CO Series 2500 includes the following pieces:

- CO analyzer with rechargeable battery pack
- Thermal printer with rechargeable battery pack
- 10 foot exhaust sample hose with water separator and 2 stage filter
- Heat shielded handle and 45 degree elbow
- 12 inch flexible probe (½ inch outer diameter)
- 12 inch narrow flexible probe (¼ inch outer diameter)
- 110 Volt AC adapter/chargers (not shown)
- Serial data interface cable (not shown)
- 2 rolls of thermal paper (not shown)
- Replacement filters (1 set)
- Protective storage case
- Operator's manuals (not shown)



ASSEMBLY & POWER

The CO Series 2500 has been calibrated at the factory. The only assembly required is to connect the exhaust sample hose to the heat shielded handle.

The analyzer uses a rechargeable battery pack as a power supply. The battery should be fully charged before the analyzer is used for the first time. See charging the analyzer battery on pages 9 and 10.

To turn the analyzer on, push the blue power ON button. To turn the analyzer off, push the red power OFF button.

FLEXIBLE PROBES

Two 12 inch flexible probes are provided with the CO Series 2500. The standard flexible probe ($\frac{1}{2}$ inch diameter) is used to sample from the exhaust pipe on most engine applications. The narrow flexible probe ($\frac{1}{4}$ inch diameter) is used in exhaust systems where the standard flexible probe cannot be inserted.

When sampling exhaust gas, either flexible probe should be inserted at least 12 inches into the exhaust system. At this depth, no air will be mixed with the exhaust sample.



WARNING: Exhaust pipe and probe assembly can be very hot. Always use the heat shielded handle when handling the probe assembly. A hot exhaust pipe and/or probe assembly can cause injury.

DISPLAY & CONTROLS

The CO Series 2500 has a digital display and simple controls designed to make the analyzer easy to operate.

% CO Display: The analyzer indicates the CO concentration in exhaust on a liquid crystal display (LCD). The LCD reports the CO in one hundredths of a percent within a range of 0.00% to 10.00%.

Power ON/OFF Buttons: These buttons turn the analyzer on and off. Using the power ON/OFF buttons is discussed in Operating the CO Series 2500 section on page 4.

Backlight Button: The display is equipped with a backlight. Using the backlight button is discussed in Operating the CO Series 2500 section on pages 7 and 8

Zero Calibration Controls: Periodically, the display of the analyzer must be set to zero. Adjusting the zero calibration controls is discussed in the Operator Maintenance section on pages 17 and 18.

Span Calibration Controls: To maintain the best measurement accuracy, occasional span calibrations should be performed with a calibration gas. Adjusting the span calibration controls is discussed in the Operator Maintenance section on pages 19-22.

Span Calibration Button: The span calibration button is used with the span calibration controls when performing a span calibration. Using the span calibration button is discussed in the Operator Maintenance section on pages 19-22.

Print Button: The print button is used to send data from the analyzer through the interface cable to the printer. Using the print button is discussed in Operation the CO Series 2500 section on pages 11 and 12.

Buttons 1, 2, and 3: These buttons are used to record and erase data in their respective memory locations. Using buttons 1, 2 and 3 is discussed in Operation the CO Series 2500 section on pages 13 and 14.



BACKLIGHT WITH AUTOMATIC SHUT-OFF

The CO Series 2500 is equipped with a backlit display to help the operator see the readings while using the analyzer in low light conditions. To turn the backlight on, push the white backlight button. The backlight operates on a timer with an automatic shut-off. The backlight will shut off after approximately one (1) minute of use.

The automatic shut-off feature is designed to limit the amount of power used by the backlight and help conserve power supplied by the battery. The automatic shut-off for the backlight cannot be disabled.



WARNING: Working on vehicles in low light conditions can be dangerous. Always work in an area with an adequate source of light. Working on vehicles in low light conditions can cause injury.

Backlit Display



Backlight Button

CHARGING THE ANALYZER BATTERY

The CO Series 2500 uses a rechargeable battery pack as a power supply. A fully charged battery pack provides approximately twelve (12) hours of continuous use. Using the backlight feature will reduce this time.

A low battery sign will be shown on the display when the analyzer battery needs to be recharged. A full recharge takes fourteen (14) hours. The analyzer can be used while the battery is being charged. If the analyzer is not in use while the battery is charging, turn the analyzer off by pushing the red power OFF button.

The following steps describe how to charge the analyzer battery:

1. Connect the transformer of the CO analyzer AC adapter/charger to a 110 Volt AC power supply.
2. Connect the cord of the CO analyzer AC adapter/charger to the CO analyzer. **Note:** The charging light should now be illuminated.
3. Let the battery pack charge for 14 hours.
4. Disconnect the cord of the CO analyzer AC adapter/charger from the CO analyzer.
5. Disconnect the transformer of the CO analyzer AC adapter/charger from the 110 Volt AC power supply.

The battery will slowly discharge even when the analyzer is turned off. If the analyzer has been out of service for a period of time, the battery will not be at full charge. Follow the above procedure to recharge the battery.



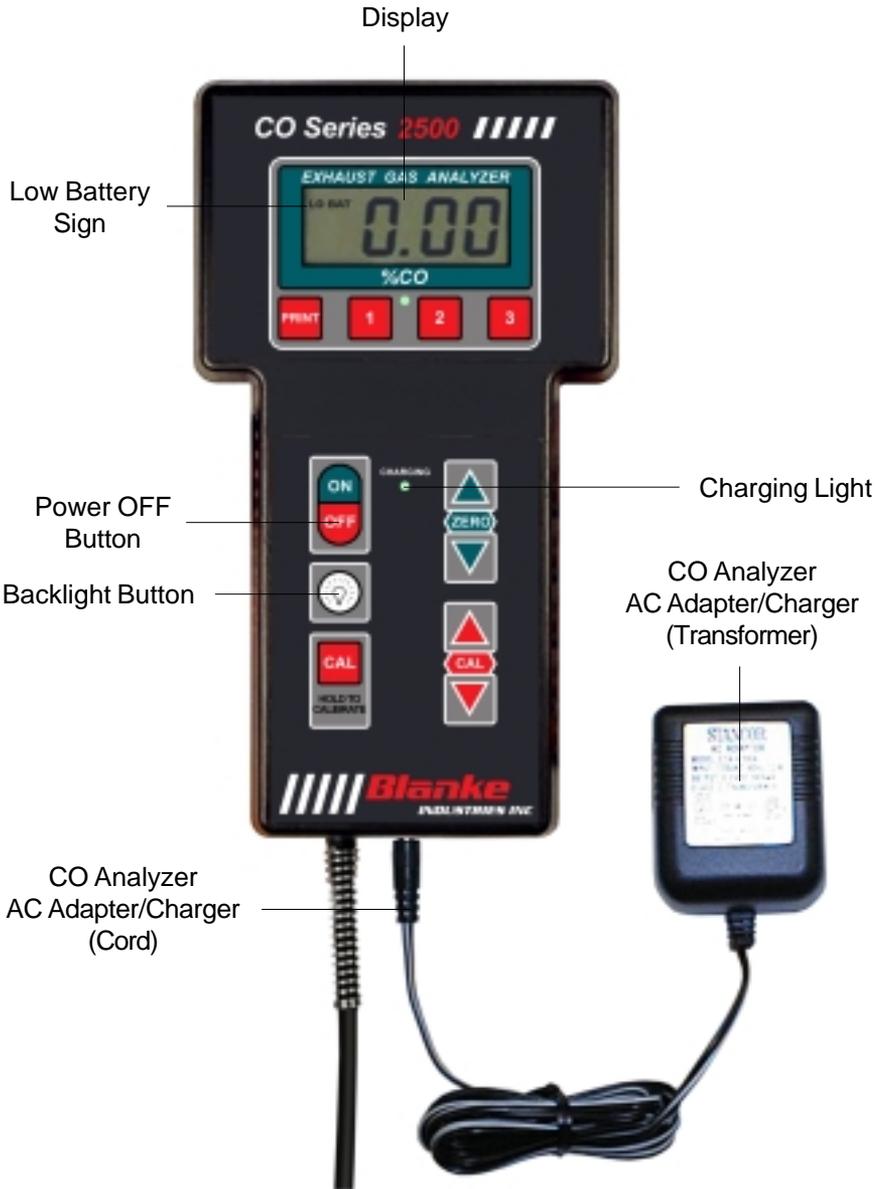
WARNING: A 110 VAC power supply can cause electrical shock. Use caution when connecting test equipment to a 110 VAC power supply. Electrical shock can cause injury.



CAUTION: To insure maximum battery life, charge the battery for 14 hours when the low battery sign is displayed. Disregarding proper charge/discharge procedures can shorten the life of the battery.



CAUTION: Use only the CO analyzer AC adapter/charger supplied to charge the analyzer battery. Using other AC adapter/chargers can damage the electronics and shorten the life of the battery.



USING THE THERMAL PRINTER

Carefully read the Thermal Printer User's Guide before using the Thermal Printer with the CO Series 2500. Refer to the Thermal Printer User's Guide for all details regarding the printer including: safety & operating precautions, assembly, power, controls, maintenance, troubleshooting and specifications.

INTERFACE CONNECTION

The following steps describe how to properly connect the interface cable between the analyzer and the printer:

1. Turn off the printer and the analyzer.

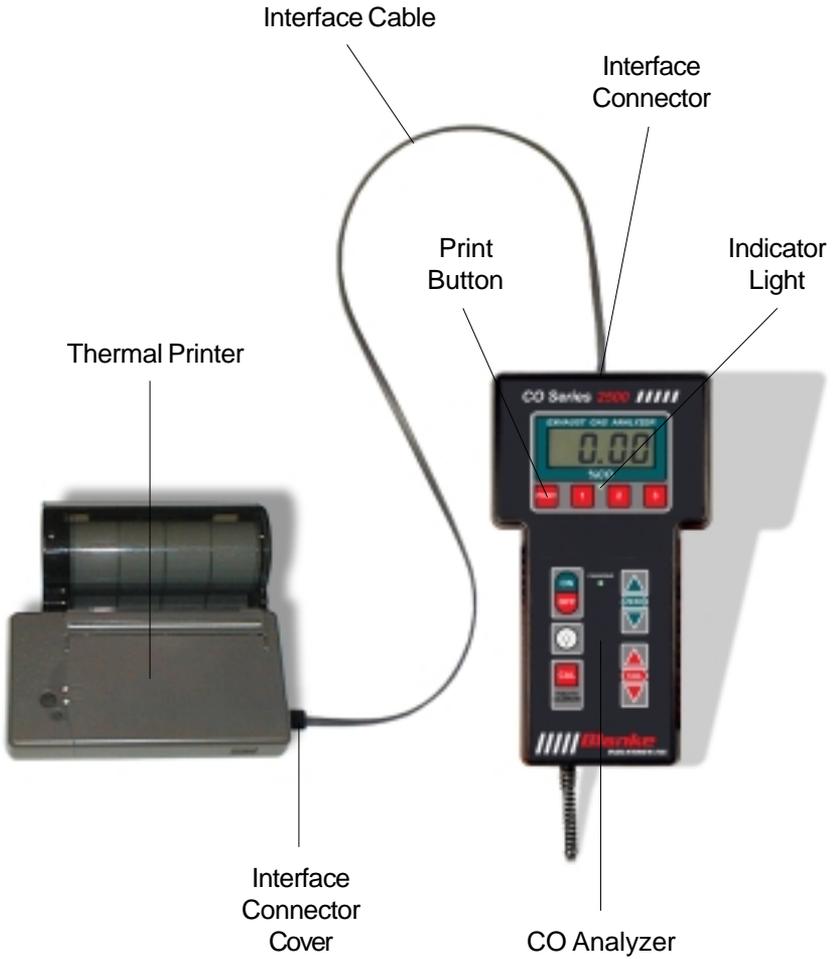
Note: The printer must be off before the interface cable is connected or a print error will occur during printing.

2. Open the rubber interface connector cover on the side of the printer and connect the interface cable.
3. Connect the interface cable to the interface connector on the analyzer.
4. Turn on the printer and the analyzer.

PRINTING DATA FROM THE DISPLAY

To print the CO concentration shown on the display of the analyzer, **push and release** the red print button on the face of the analyzer. Pushing and releasing the print button sends data from the display of the analyzer through the interface cable to the printer. When the print button is pushed and released, the green indicator light will flash once. After the indicator light flashes, the printer will begin to print.

Printing the CO concentration(s) saved in memory is discussed in Operating the CO Series 2500 section on pages 13 and 14.



USING THE MEMORY

The CO Series 2500 is equipped with three (3) memory locations. Each memory location can store emission test results during various modes of engine operation. Button 1 is used to record CO concentrations while an engine operates at idle speed. Button 2 is used to record CO concentrations while an engine operates at cruise (high idle) speed. Button 3 is used to record CO concentrations while an engine operates under a loaded condition.

RECORDING DATA INTO MEMORY

To record the CO concentration shown on the display of the analyzer, **push and release** the red button 1, 2 or 3 on the face of the analyzer. Pushing and releasing any of these buttons stores data from the display into the respective memory location. When any of these buttons are pushed and released, the green indicator light will flash once indicating the data has been stored into memory. Data stored into memory can also be overwritten by pushing and releasing button 1, 2 or 3.

PRINTING DATA FROM THE MEMORY

To print the CO concentration(s) saved in the memory of the analyzer, **push and hold** the red print button on the face of the analyzer. Hold the print button until the green indicator light turns on. There will be a slight delay (less than 2 seconds) before the light turns on. After the light turns on, release the print button.

When printing data from the memory, the printer will only print information from the memory locations which have stored data. If a memory location is empty (erased), no CO concentration will be printed for that memory location. If all three memory locations are empty, the message "No Test Results Stored in Memory" will be printed.

ERASING DATA FROM THE MEMORY

To erase the CO concentration(s) saved in any single memory location, **push and hold** button 1, 2 or 3. Hold button 1, 2 or 3 until the green indicator light turns on. There will be a slight delay (less than 2 seconds) before the light turns on. After the light turns on, release the button. When the analyzer is turned off, all three memory locations are erased.



The CO Series 2500 is designed to operate with very little maintenance. Maintenance is limited to only three areas:

- Water separator with 2 stage filter
- Zero calibration
- Span calibration

WATER SEPARATOR

Water is a by-product of the combustion process. Water leaves the engine as a vapor. As the hot exhaust is cooled, the water vapor condenses into a liquid. When testing emissions, this condensation collects in the exhaust sample hose.

To prevent damage to the analyzer, the sample hose is equipped with an in-line water separator. For best results, position the water separator so it hangs vertically below the analyzer. Always keep the hose lower than the analyzer. If the hose is higher than the analyzer, water in the hose can run into the analyzer.



CAUTION: Water in the analyzer can damage the internal components. Always keep the hose lower than the analyzer. Never allow the water separator to fill more than half way.

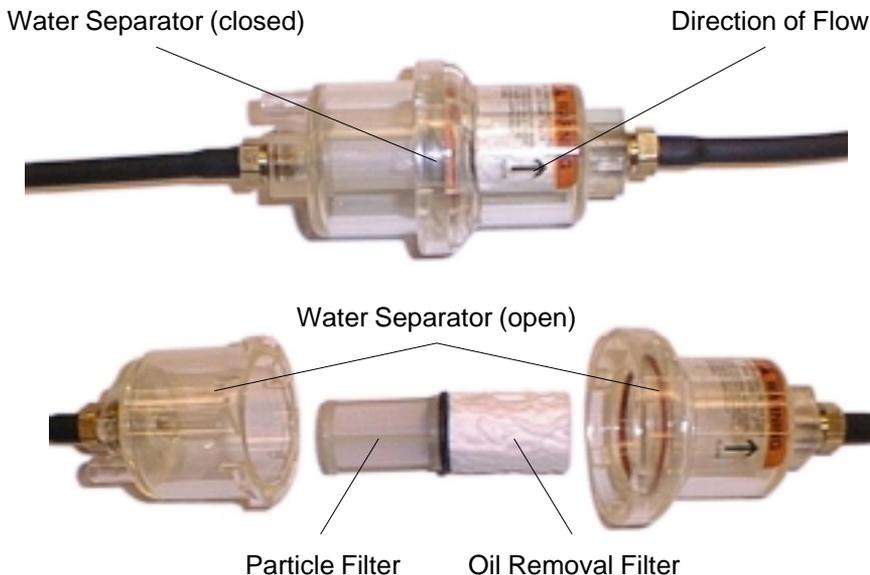
2 STAGE FILTER

The 2 stage filter is made up of a particle filter and an oil removal (coalescing) filter. These filters are housed inside the water separator. An arrow indicates the proper direction of flow through the water separator.

The position of the 2 stage filter within the water separator depends on the type of engine being tested. When testing a standard 4 cycle combustion engine, the best position for the 2 stage filter is: particle filter followed by oil removal filter (as shown on page 16). When testing a diesel engine or a 2 cycle combustion engine, the best position for the 2 stage filter is: oil removal filter followed by particle filter.

DRAINING THE WATER SEPARATOR

After prolonged testing, the water separator may begin to fill with water. To open and drain the water separator, gently push the two halves together and twist counterclockwise. To close the water separator; align the posts and slots, then gently push the two halves together and twist clockwise until they lock.



CLEANING/REPLACING THE 2 STAGE FILTER

Over time, the particle filter and oil removal filter which are mounted in the water separator will need to be cleaned or replaced. The filters can be cleaned with soap and warm water. The filters should be cleaned when they become significantly discolored. When the filters are beyond cleaning, replacement filters are available. Replacement filters are discussed in the Warranty & Service section on pages 25 and 26.



CAUTION: Particles in the exhaust sample can damage the internal components of the analyzer. Never sample exhaust without the 2 stage filter installed. The filters should be maintained regularly.

ZERO CALIBRATION

Zero calibration eliminates measurement errors caused by changes in temperature. The analyzer should be zeroed to display $0.00\% \pm 0.01$ each time the unit is turned on. The unit should also be zeroed before each emission test.

The zero calibration controls are found on the front panel of the analyzer. Push the blue up arrow to increase the readings on the display. Push the blue down arrow to decrease the readings on the display.

The following steps describe how to perform a zero calibration:

1. Push the blue power ON button to turn the analyzer on.
2. Wait for approximately 30 seconds, or until the readings on the display stabilize.
3. Adjust the zero calibration controls so the display reads $0.00\% \pm 0.01$.

Display



Power ON
Button

Zero Calibration
Controls

SPAN CALIBRATION

Span calibration eliminates measurement errors caused by large changes in ambient temperature and barometric pressure as well as long term changes in the analyzer's electrochemical sensor cell. To help maintain the best measurement accuracy, monthly span calibrations with a calibration gas are recommended.

The span calibration controls are found on the front panel of the analyzer. The span calibration controls will only function while the red span calibration button is pushed and held down. Push the red up arrow to increase the readings on the display. Push the red down arrow to decrease the readings on the display. The span calibration controls will have no effect on the reading without pushing and holding the span calibration button.

CALIBRATION GAS

A cylinder of calibration gas and the appropriate calibration kit are required to perform the following span calibration procedure. Ordering information for these accessories is discussed in the Warranty & Service section on pages 25 and 26.

For best accuracy, span calibration should be performed at or near the CO emissions level expected from a particular engine application. Two concentrations of calibration gas are available for use with the analyzer; a 1.0% CO blend and a 4.0% CO blend.

To determine which calibration gas should be used, check the proper CO emissions standards for your engine application. Choose the CO blend which is closest to the emissions standards for your application.

The calibration gas cylinders contain 8 cubic feet of compressed gas. One cylinder of gas will provide approximately 120 minutes of use at the proper flow rate of 4.0 SCFH. The cylinders are nonrefillable.

HYDROGEN CROSS-SENSITIVITY

The CO sensor in this analyzer has a cross-sensitivity to hydrogen gas. This means when the sensor is exposed to hydrogen, it produces a signal as if it were reading CO. Hydrogen happens to be a by-product of the combustion process. To keep the readings accurate, the hydrogen cross-sensitivity is filtered out electronically by a special circuit in the analyzer.

There is no hydrogen in the cylinder of calibration gas. Therefore, while the unit is being span calibrated, the electronic filter must be temporarily disabled. Pushing and holding the span calibration button disables or turns off the filter.

When performing the span calibration procedure, the value on the display will be lower if the calibration button is released and the electronic filter is operating. This is how the analyzer is designed to operate.

SPAN CALIBRATION (continued)

The following steps describe how to perform a span calibration:

1. Connect the flow meter to the cylinder of calibration gas.
Note: Mount the flow meter vertically to insure proper operation.
2. Follow steps 1 through 3 of the zero calibration procedure on page 17.
3. Disconnect the exhaust sample hose from the sample port on the analyzer.
4. Open the valve on the cylinder of calibration gas and adjust the flow rate to deliver approximately 4.0 SCFH (the ball will bounce slightly).
5. Push and hold the red span calibration button on the front of the unit.
6. Connect the hose from the calibration gas to the sample port.
7. Wait for approximately 30 seconds, or until the readings on the display stabilize.
8. Adjust the span calibration controls so the display reads the CO concentration in the calibration gas cylinder ± 0.01 .
9. Disconnect the hose from the calibration gas to the sample port.
10. Release the red span calibration button on the front of the unit.
11. Close the valve on the cylinder of calibration gas.
12. Connect the exhaust sample hose onto the sample port.
13. Repeat step 3 of the zero calibration procedure on page 17.



WARNING: Calibration gas contains carbon monoxide (CO). Use calibration gas only in a well ventilated area. Prolonged exposure to CO can cause headache, nausea, dizziness, fatigue or death.



MAINTENANCE SCHEDULE

ACTION	INTERVAL
Drain Water Separator:	Drain after every 10 minutes of sampling or as needed. Draining the water separator is discussed in the Operator Maintenance section on page 16.
Clean 2 Stage Filter:	Clean the 2 stage filter after every 10 hours of testing or as needed. Cleaning the 2 stage filter is discussed in the Operator Maintenance section on page 16.
Replace 2 Stage Filter:	Replace the 2 stage filter every 90 days or as needed. Replacing the 2 stage filter is discussed in the Operator Maintenance section on page 16.
Zero Calibration:	Zero calibration is recommended before every emissions test or as needed. Zero calibration is discussed in the Operator Maintenance section on pages 17 and 18.
Span Calibration:	Span calibration is recommended once a month or as needed. Span Calibration is discussed in the Operator Maintenance section on pages 19-22.
Replace CO Sensor:	Replace the CO sensor approximately every 3-5 years or when the analyzer can no longer be span calibrated with a calibration gas. Replacing the CO sensor is discussed in the Warranty & Service section on pages 25 and 26.
Replace Battery:	Replace the CO analyzer battery pack after approximately 1000 full charge and discharges or as needed. Replacing the battery is discussed in the Warranty & Service section on pages 25 and 26.

TROUBLESHOOTING GUIDE

SYMPTOM	SUGGESTED SOLUTION(S)
Does not turn on	Charge the battery, see pages 9 and 10.
Low battery sign is on	Charge the battery, see pages 9 and 10.
Battery loses charge when not in use	This is normal, see charging the battery on pages 9 and 10.
Battery life seems short	Charge the battery, see pages 9 and 10. Replace CO analyzer battery pack, see pages 25 and 26.
Backlight button does not turn off the backlight	This is normal, see backlight with automatic shut-off on page 7.
Does not read 0.0% when sampling fresh air	Perform a zero calibration, see pages 17 and 18.
CO readings are unusually low	Make sure the flexible probe is at least 12” into the exhaust system. Drain condensation from the water separator and/or the exhaust sample hose. Check for leaks in the sampling system and/or the exhaust system. Perform a span calibration, see pages 19-22.
Response time is greater than 10 seconds	Clean & dry the oil removal filter, see pages 15 and 16.
Does not span calibrate with calibration gas	Replace CO sensor, see pages 25 and 26.
CO readings change when the calibration button is pushed	This is normal, see hydrogen cross-sensitivity on page 20.
Display is erratic	Charge the battery, see pages 9 and 10.

LIMITED WARRANTY AND SERVICE POLICY

Blanke Industries, Inc. warrants the CO Series 2500 Exhaust Gas Analyzer to be free from defects in materials and workmanship for a period of **one year** from date of purchase when used and maintained according to the procedures set forth in this manual. Any product which fails in this period because of defects in material or workmanship, and has not been damaged by abuse, negligence, accident or incorrect use, and is returned to Blanke Industries, Inc., with transportation charges prepaid, will be repaired or replaced, at factory option, free of charge and returned to the sender with the transportation charges prepaid anywhere in the continental United States. Cables, hoses, filters and probe assemblies are not covered by this limited warranty. Unauthorized modifications or repairs will void Blanke Industries' liability under this warranty policy.

Blanke Industries' sole responsibility and buyer's exclusive remedy is limited to repair or replacement of the product as stated above. **THERE ARE NO OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THOSE OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND BLANKE INDUSTRIES SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE SALE OR USE OF THIS PRODUCT.**

Blanke Industries, Inc. utilizes United Parcel Service (UPS) ground service as a standard means of shipping for both warranty and non-warranty repairs. Any special shipping request over and above the cost of standard UPS ground service will be the responsibility of the buyer.

To make warranty claims, obtain service information, order replacement parts or optional accessories, contact us at:

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Web site: www.blankeindustries.com

Customer service is available during regular business hours, 8:00 AM to 5:00 PM (Central Time), Monday through Friday.

REPLACEMENT PARTS

DESCRIPTION	PART #
12" Flexible probe (½" O.D.)	FP-050
12" Narrow flexible probe (¼" O.D.)	FP-025
10' Exhaust sample hose	SH-010
Particle filters, 75 micron (pack of 3)	PF-375
Oil removal (coalescing) filters, 5 micron (pack of 3)	CF-305
CO sensor	COS-100
CO analyzer AC adapter/charger	AC-110
Printer AC adapter/charger	PC-110
CO analyzer battery pack	BP-060
Printer battery pack	BP-072
Thermal paper (6 rolls)	TP-619
Interface cable	IC-606
Operator's manual	OM-250

OPTIONAL ACCESSORIES

DESCRIPTION	PART #
Customized printout (printer upgrade)	CP-100
Calibration kit (w/o calibration gas)	CK-050
Calibration gas cylinder (1.0% CO)	CG-010
Calibration gas cylinder (4.0% CO)	CG-040

SPECIFICATIONS

General:	
Battery	Rechargeable NiCad
Typical battery life	Over 12 hours of continuous use ⁽¹⁾⁽²⁾
Start-up time	Instant "on", no warm-up
Construction	Rugged, fuel and oil resistant, ABS plastic
Sample flow rate	Approximately 72 in ³ /min (1180 ml/min)
Operating temperature	35 to 104°F (2 to 40°C)
Storage temperature	10 to 122°F (-10 to 50°C)
Humidity range	10-90% (non-condensing)
User calibration	Monthly or as needed
CO:	
Sensor type	Electrochemical
Sensor life	Typically 3-5 years
Range	0-10%
Resolution	0.01%
Response time	Less than 10 seconds to 90% of full scale
Accuracy	±5% of reading ⁽³⁾
Repeatability	±5% of reading ⁽³⁾
Physical:	
Dimensions	9.3" L x 5.2" W x 1.8" H
Weight	2.40 pounds (1.09 kg)
Display	3½ digit LCD, ¾" digit height, backlit
Probe(s)	12" flexible steel, ½" O.D. & ¼" O.D.
Sample hose	10' length x ¼" O.D.
2 stage filter	75 micron particle, 5 micron oil removal

⁽¹⁾ Typical battery life is based on proper charge/discharge practices.

⁽²⁾ Using the backlight feature will reduce the typical battery life.

⁽³⁾ Analyzer will meet accuracy and repeatability specifications when zero and span calibrated in the environment of use.

All specifications and features are subject to change without notice.

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