



MICROGAS ANALYZER USER GUIDE

Gas 2000

NEXT GENERATION INFORMATION SYSTEM



IMPORTANT NOTICE

SAFETY

All Danger, Warning and Important notes must be followed for your safety. These safety messages will be in the following formats:

- **Danger** means you may risk possible loss of life
- **Warning** means you may risk bodily harm
- **Important** means you risk damage to the vehicle or the tool
- **Notes** are added to provide clarity and helpful tips.

These safety messages cover situations SPX is aware of. SPX cannot know, evaluate and advise you as to all of the possible hazards. You must be certain that any conditions or service procedures encountered do not jeopardize your personal safety.

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MicroGas Analyzer

User Guide

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Safety Precautions



DANGER

- When an engine is operating, keep the service area **WELL VENTILATED** or attach a building exhaust removal system to the engine exhaust system. Engines produce carbon monoxide, an odorless, poisonous gas that causes slower reaction time and can lead to serious injury or death.



WARNING

- Set the parking brake and block the wheels before testing or repairing the vehicle. It is especially important to block the wheels on front-wheel drive vehicles because the parking brake will not hold the drive wheels.
- Do not drive the vehicle and operate the analyzer at the same time. Any distractions may cause an accident. Have one person operate the analyzer as another person drives the vehicle.
- Be sure there is adequate clearance from moving components. Moving components and belts can “catch” loose clothing, parts of your body or the test equipment and cause serious damage or personal injury.
- Wear an American National Standards Institute (ANSI) approved eye shield when analyzing or repairing vehicles. Objects propelled by whirling engine components or liquids escaping under pressure can cause serious injury.



IMPORTANT

- The MicroGas analyzer is not designed for use on diesel or two-cycle engines. The particulate will clog hoses, filters and internal components. The presence of diesel particulate inside the MicroGas analyzer will void the warranty.
- Do not use solvent-based cleaners on any part of the MicroGas analyzer or the hoses. Solvents may cause permanent damage. A solution of warm water and mild detergent is the only cleaning agent recommended. Thoroughly air dry before reuse.
- Failure to clean and drain the Base Air and Moisture filter will void the warranty. The filter must be inspected for blockage or moisture on a daily basis.

Getting Started

MicroGas Analyzer

The MicroGas Analyzer is a portable gas analysis unit that measures and graphs the levels of Carbon Monoxide, Carbon Dioxide, Hydrocarbon, Oxides of Nitrogen and Oxygen emitted in the exhaust of an internal combustion engine. Data for each of the five gases plus the Air-to-Fuel ratio and the Lambda value are displayed and graphed on a single screen for side-by-side analysis and review of each gas. The MicroGas Analyzer is activated and controlled with the Next Generation Information System tool.

MicroGas Analyzer kit components

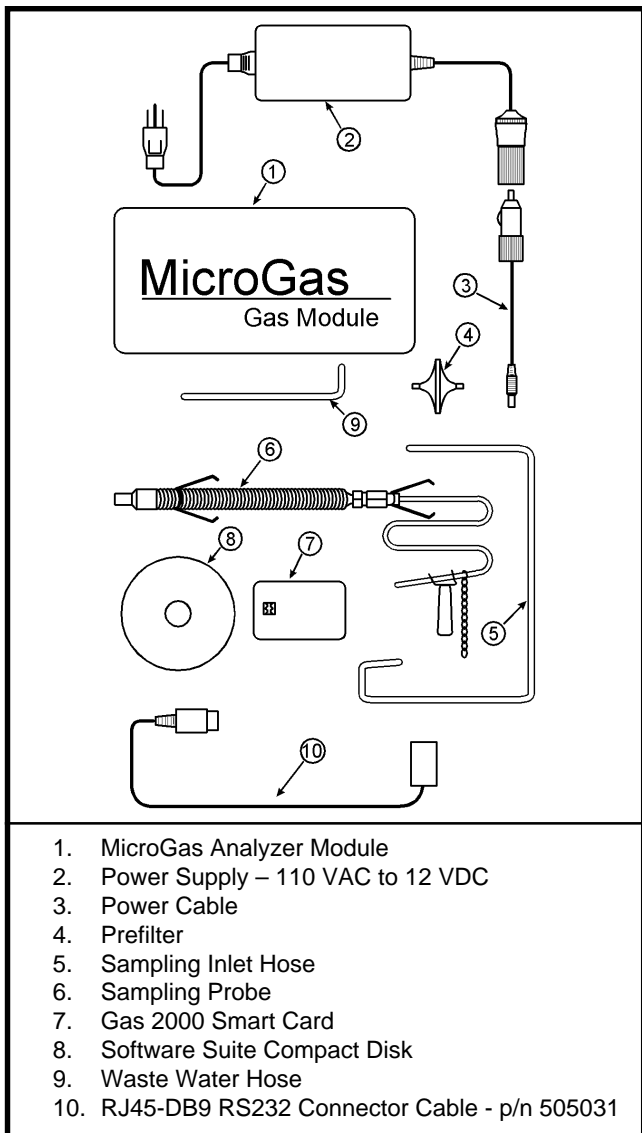


Figure: MicroGas Analyzer Kit Components

Next Generation Information System components

The Next Generation Information System tool components illustrated in Figure: Next Generation Information System Tool Components are not included with the MicroGas Analyzer kit but are required for MicroGas Analyzer communications and control.

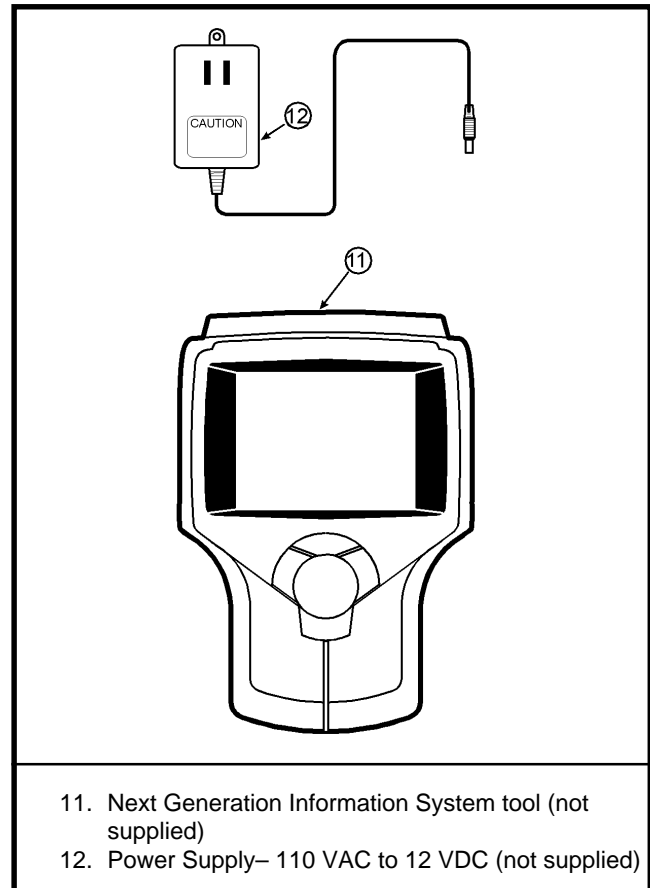


Figure: Next Generation Information System Tool Components

MicroGas 2000 Program Software

The Next Generation Information System tool and the Gas 2000 program activate and control the MicroGas Analyzer. The Gas 2000 program is provided on a compact flash, compact disk or downloaded from the SPX Internet web site. The Gas 2000 program must be installed onto the Next Generation Information System tool before the MicroGas Analyzer can be activated. Complete instructions for installing program software are located on a separate instruction sheet entitled, "*Next Generation Information System Tool Software Installation.*" Locate the software installation instruction sheet and install the Gas 2000 software onto your Next Generation Information System tool now.

MicroGas Analyzer Setup

A small amount of equipment setup is necessary before exhaust emissions testing can begin. View Figure: Gas Analyzer Setup and follow the MicroGas Analyzer setup steps. The Gas 2000 software program must be installed onto the Next Generation Information System tool before the MicroGas Analyzer can be set up. Install the Gas 2000 program onto the tool now if you have not already completed this step.

How to set up the MicroGas Analyzer

To prepare the MicroGas Analyzer, follow these steps:

1. View Figure: Gas Analyzer Setup for the steps that follow. To begin, there are two methods to supply power to the Next Generation Information System tool. The tool has an internal battery that supplies power for approximately 2 hours of continuous operation. Alternatively, the Next Generation Information System tool can be connected to it's own Power Supply (provided with the Next Generation Information System tool kit). If an external power source is required, connect the Power Supply (item 12) into a 110 volt wall outlet and into the Power Port located on the top of the Next Generation Information System Tool (item 11).

2. Connect the RJ45-DB9 RS232 Connector Cable–p/n 505031– (item 10) to the Next Generation Information System tool RS-232 serial Port and to the MicroGas Analyzer DB9 Serial Port.

Important: The RJ45-DB9 RS232 Connector cable–p/n 505031–must be used with the MicroGas. An RJ45-DB9 RS232 Connector cable supplied with the Next Generation Information System tool is very similar in appearance but *will not* work with the MicroGas.

3. Connect the Power Supply (item 2) provided with the MicroGas Analyzer into a 110 volt wall outlet. Connect the Power Cable (item 3) into the Power Supply socket and into the MicroGas Analyzer Power Port.
4. Connect the Prefilter (item 4) to the MicroGas Analyzer Inlet port and to the Sampling Inlet Hose (item 5).
5. Connect the Sampling Probe (item 6) to the Sampling Inlet Hose (item 5).
6. Route the Waste Water Hose (item 9) away from the vehicle or into a suitable receptacle.

The MicroGas Analyzer and the Next Generation tool setup is complete.

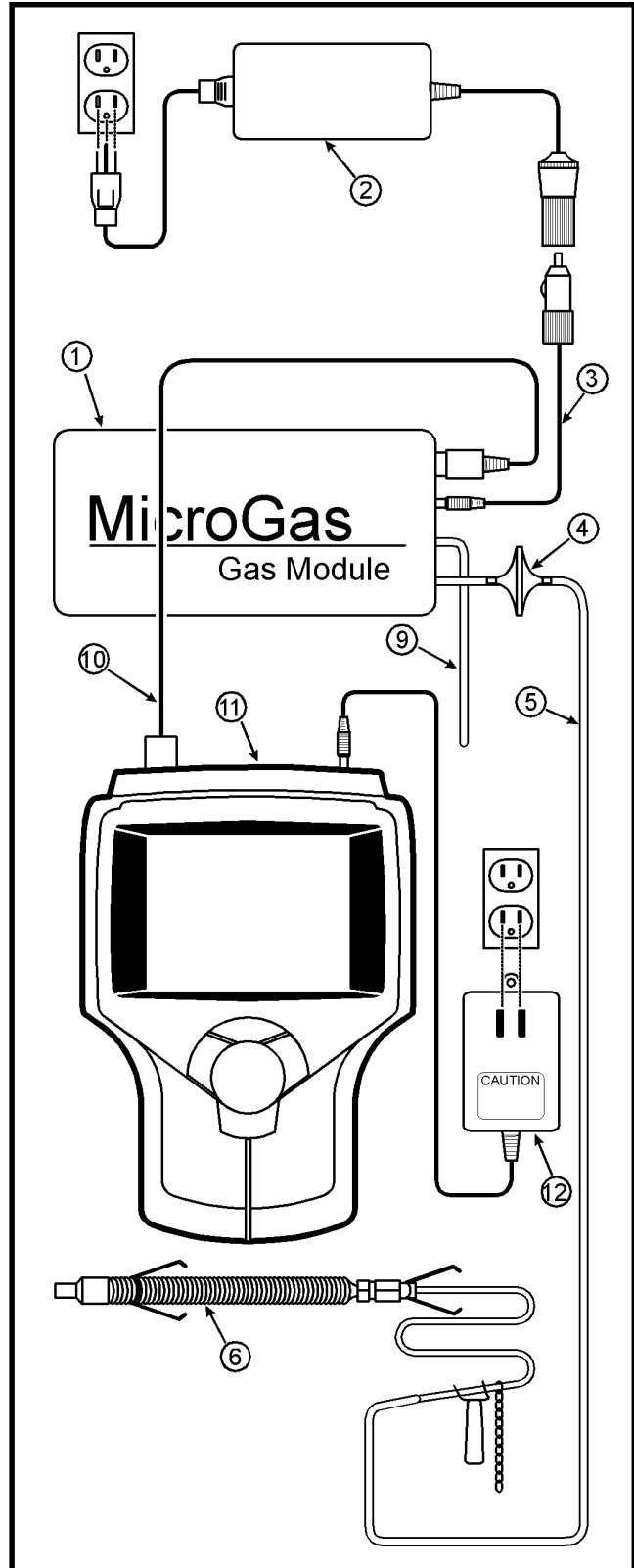


Figure: Gas Analyzer Setup

Gas Analysis

Emissions Gas Analysis

One pound of gasoline burned with 14.7 pounds of air produces Carbon Dioxide (CO₂), water vapor (H₂O), and heat. In an internal combustion engine, other factors such as changing air to fuel mixture ratios, inconsistent air temperature and defective engine components combine to produce an inconsistent mixture ratio. As the ratio changes, undesirable pollutants such as Carbon Monoxide (CO), Hydrocarbons (HC), Oxides of Nitrogen (NOX), Sulfur Dioxides (SO₂) and soot are produced along with water vapor (H₂O), Carbon Dioxide (CO₂) and heat.

The Microgas Analyzer samples the vehicle exhaust and analyzes the ratios of the five primary gases that make up vehicle exhaust. Gas ratios higher or lower than what is expected at an air-to-fuel ratio of 14.7 to 1 can indicate worn engine components or pollution control components in need of replacement. Additional information for expected gas ratios is located in the Appendix of this manual.

How to perform an Emissions Live Gas Analysis on-vehicle

To perform an Emissions Live Gas Analysis, follow these steps:

1. The MicroGas Analyzer and the Next Generation tool setup should be completed as described in "MicroGas Analyzer Setup." Do this step now if it has not been completed.
2. Press the Next Generation tool power button (located on top of the tool) to turn the tool "on."
3. Select **Gas 2000** from the Application Manager menu. Press ENTER.



Figure: Application Manager Menu

4. The tool will automatically initialize (approximately 40 seconds) the operating system. The MicroGas Control Menu will be displayed on the screen when initialization is complete.

Note: A failure to initialize will display an Error message. Press the function key labeled **Info**, then follow the directions in the Error message for remedy.

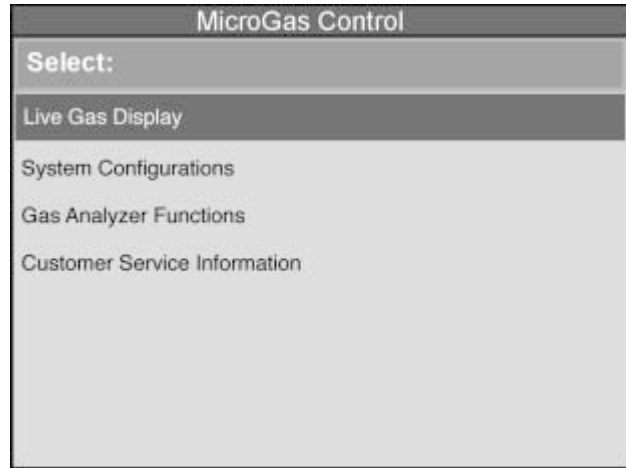


Figure: MicroGas Control Menu

- Enter the fuel used for the vehicle. To do this step, select **Customer Service Information** from the MicroGas Control menu, and then select **Vehicle Specifics**.
- Select **Fuel Type**, then press up or down to select **Gas**, **Propane**, **Methane** or **Variable**. The HCV and OCV constant of the fuel selected will be displayed. Press the function key labeled **OK** to continue.

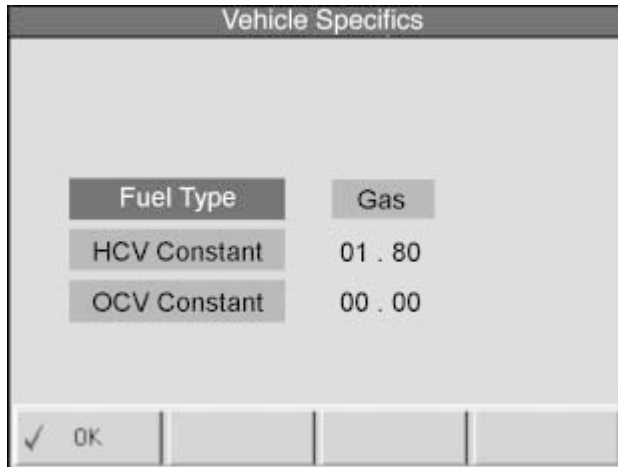


Figure: Fuel Type



Warning:

The MicroGas Analyzer is not designed for use on diesel or two-cycle engines. Exhaust particulate will clog filters and internal components. Using the MicroGas Analyzer on a diesel or two-cycle engine will void the warranty.

- Select **Live Gas Display** from the MicroGas Control menu, press ENTER. This will initiate an automatic "zero" test. If you are connected to a test vehicle exhaust, remove the Sampling Probe from the vehicle exhaust pipe. Follow the on-screen instructions to complete the procedure.

Important: The "zeroing" test must sample air that is free of exhaust or chemical fumes to establish a base set of gas ratios before testing. Place the Sampling Probe about two feet above the floor and away from exhaust gas or chemical fumes.

- When the zeroing of the sampling probe is completed, insert the sampling probe as far as it will go into the vehicle exhaust pipe. The tension wires on the sampling probe must be fully inserted. If the tension wires become stuck in the muffler, slide them down the probe away from the muffler.

Important: The vehicle exhaust system must be free of air leaks. Any air entering the exhaust stream through holes in the exhaust system will dilute the exhaust gases and produce inaccurate gas ratios.

- To setup a single exhaust: Insert the sampling probe as illustrated. If a road test is necessary, securely fasten the safety chain to the vehicle. See Figure: Single Exhaust Setup.

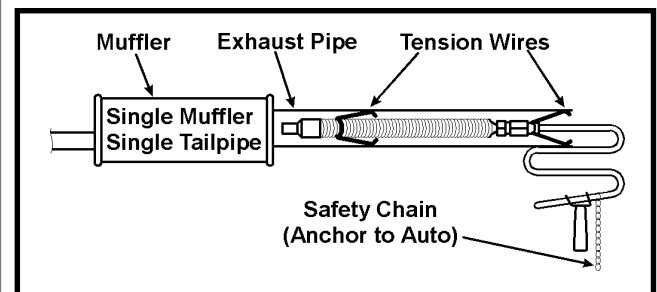


Figure: Single Exhaust Setup

- To setup a single exhaust with dual tailpipes: Insert the sampling probe as illustrated. Block one outlet to prevent air entering and diluting the exhaust. If a road test is necessary, securely fasten the safety chain to the vehicle. See Figure: Single Exhaust/Dual Tailpipe Setup.

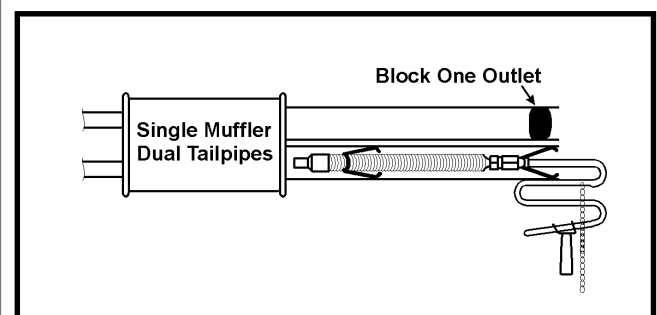


Figure: Single Exhaust/Dual Tailpipe Setup

- To setup a dual exhaust: Insert the sampling probe as illustrated. If a road test is necessary, securely fasten the safety chain to the vehicle. Measure the emission at each tailpipe for accurate results. See Figure: Dual Exhaust Setup.

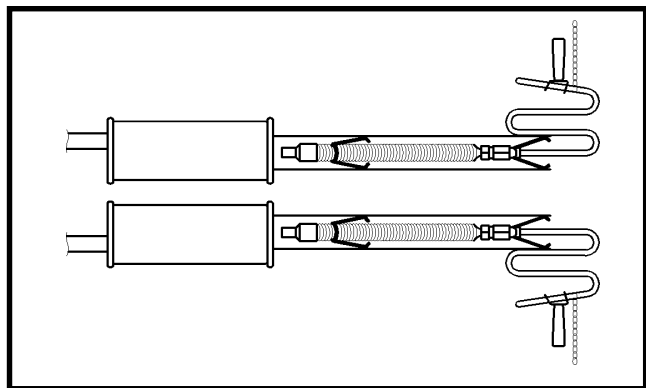


Figure: Dual Exhaust Setup

9. A screen showing the ratios of the five gases plus the Air-to-Fuel ratio and Lambda is displayed. Typical ratios are:
- **Hydrocarbons (HC) = 90 parts per million (ppm)**
 - Oxygen (O₂) = 0.5%
 - Carbon Monoxide (CO) = 0.5%
 - Carbon Dioxide (CO₂) = 14%
 - Oxides of Nitrogen (NOX) = 2,000 parts per million (ppm)
 - Air-to-fuel (AFR) = 14.7
 - Lambda = 1.0

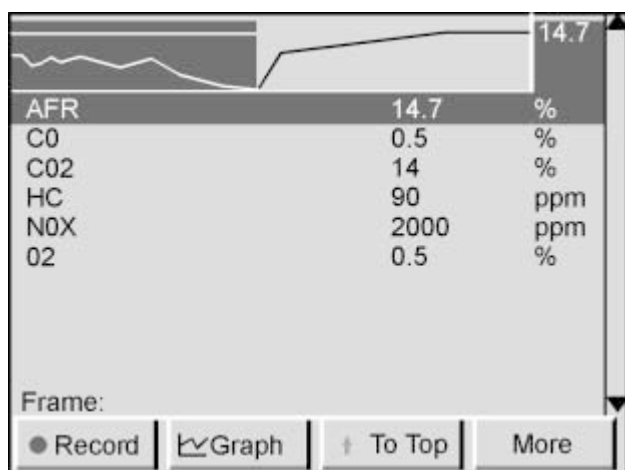


Figure: Live Gas Analysis

Additional information for gas analysis is located in the Appendix of this manual.

Gas Analysis Functions and Features

Analysis functions and features available for detailed gas analysis include the following tools:

- **Graph** – real-time graphic view that can be “frozen” for closer analysis
- **Freeze Frame** – “freeze” data acquisition and back up through history to view and analyze gas ratio behavior
- **Zoom** – view expanded numerical or graphic data
- **Sort** – numerical or graphic data is arranged alphabetically or by most active
- **Position** – place a selected item at the top of the display
- **Record and Playback** – capture gas data to view at a later time or to determine the average mass of the gases in grams per mile (GPM)
- **Average Mass** – calculate the average mass for each of the gases over specified points in time.

GRAPH

The graphic display divides the data into two windows: a past activity window and a magnified live activity window. Within the magnified window a dotted line “cross-hair” can be moved over the data to freeze and magnify any part of the captured data. As data is graphed, the minimum and maximum measurements are displayed along with the actual measurement.

Graph Activation

To graph data, follow these steps:

1. From the **Live Gas Display** window, select the gas or measurement to graph, and then press the GRAPH/DISPLAY function key (see Figure: Live Gas Display).
2. To disable the graph, press the GRAPH function key again to toggle the graph function off.

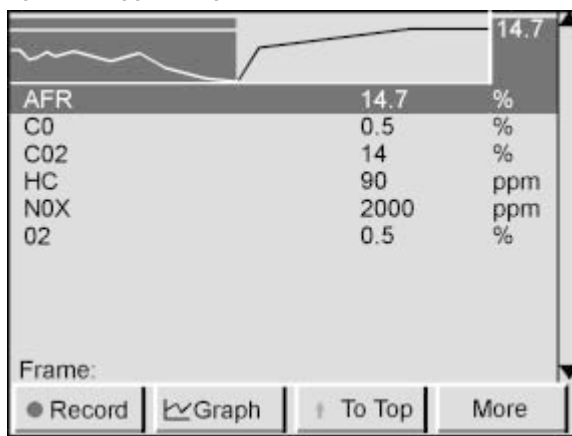


Figure: Live Gas Display

Note: The Graph function key also disables or enables the data activity display. Pressing the Graph function key will toggle the data display between Graph On/ Data Disable/ Data Enable/ Graph Off.

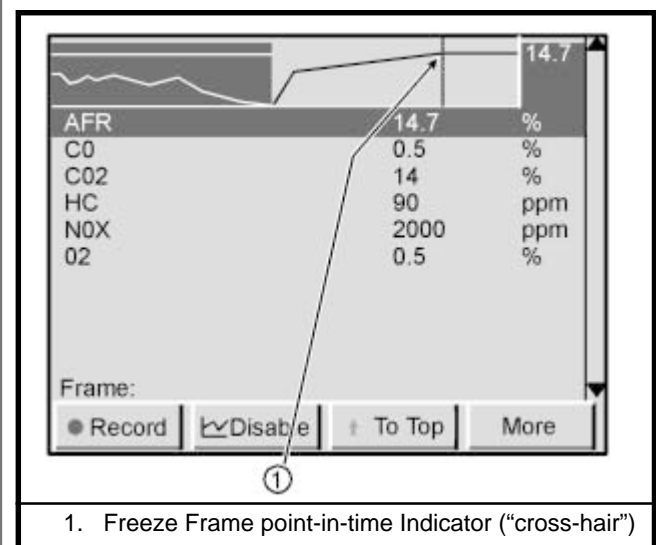
FREEZE FRAME

The Freeze Frame function instantly “freezes” the data as it is viewed. The data can be viewed frame-by-frame as the vertical “cross-hair” is moved to visually indicate the exact frame for a particular point in time. The graphed data will be magnified when the cross-hair moves across each frame.

How to Freeze data

To “Freeze” data, follow these steps:

1. Press the DIRECTION key left to move the vertical “cross-hair” (see Figure: Freeze Frame). The vertical cross-hair will move to visually indicate the exact frame for a particular point in time. The graphed data will be magnified as the cross-hair is moved left or right across the graph.
2. Continue to press the left or right side of the directional key to move back or forward frame-by-frame.
3. Record the data, if desired, by simply pressing the RECORD key.
4. Press EXIT to resume live data graphing.



1. Freeze Frame point-in-time Indicator (“cross-hair”)

Figure: Freeze Frame

ZOOM

The Zoom function magnifies the numerical and graph displays.

Zoom up or Down

To zoom a data view, follow these steps:

1. Select the numerical data or graph, and then press the MORE function key.
2. Select ZOOM, and then press ENTER to increase or decrease the selected sensor view.

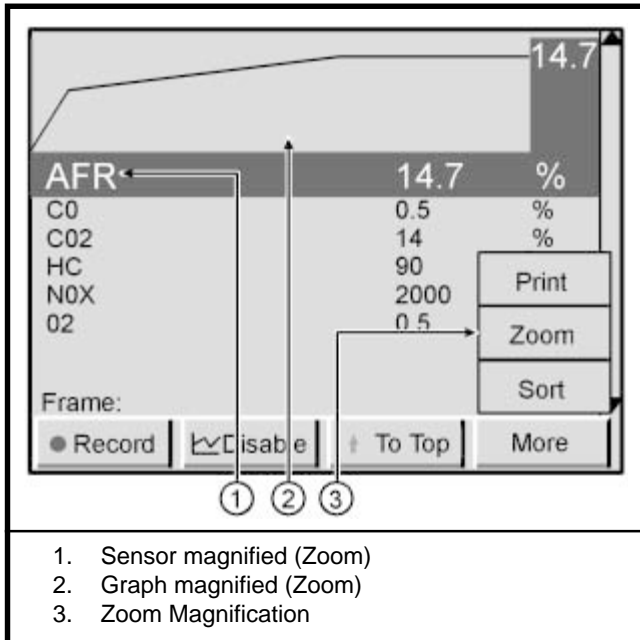


Figure: Zoom Magnification

SORT

The gases displayed can be ordered alphabetically, by the most active or by all graphed gases.

How to Sort the Gas Display Sequence

To sort the gas display, follow these steps:

1. Press the MORE Function key, press SORT, and then press ENTER.

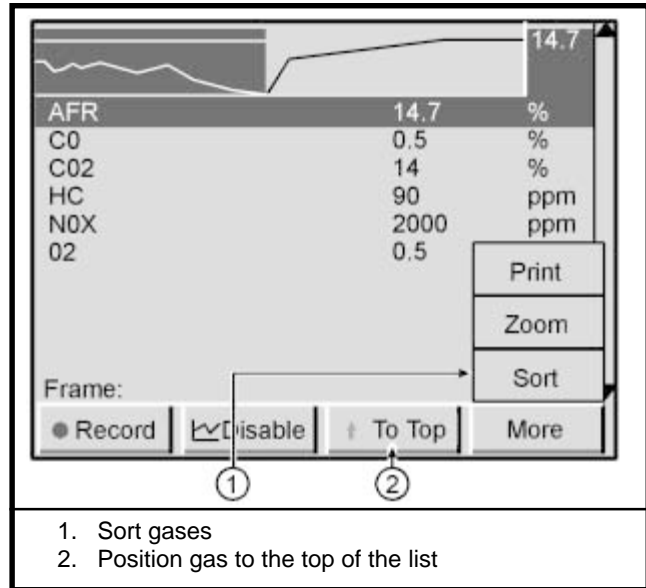


Figure: Sort Gas

2. Select a method to sort the list of gases, and then press ENTER.

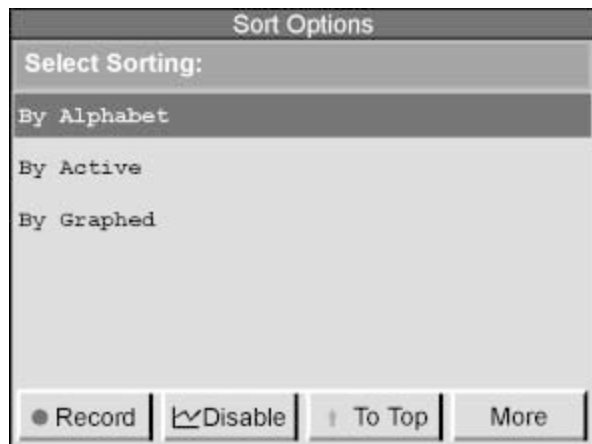


Figure: Sort Menu

GAS POSITION

The display sequence of the gases and AFR or Lambda is easily re-arranged to allow the configuration of a grouping of gases at the top of the screen for convenient side-by-side viewing.

How to Position the Gas Display Sequence

To reposition a gas, select it, and then press the TO TOP function key. Each gas selected is positioned to the top of all remaining gases. See Figure: Sort Gases.

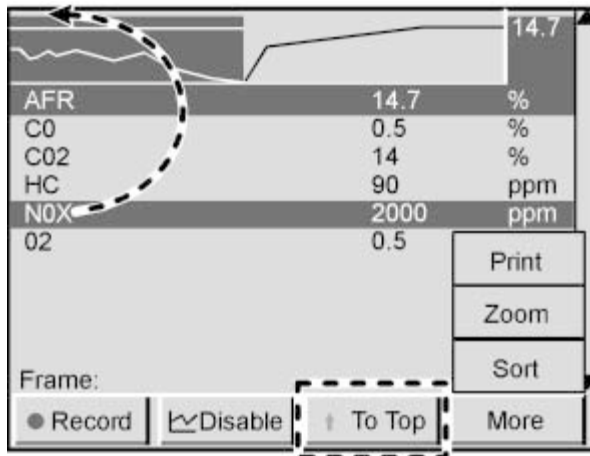


Figure: Sort Gases

RECORD AND PLAYBACK

The Record function captures data information: To activate a recording, press the RECORD key to capture up to 150 frames of data that occurred before and after the trigger was pressed. The data is automatically recorded to a file and placed in the playback folder for playback viewing at any time.

To Record and Playback data

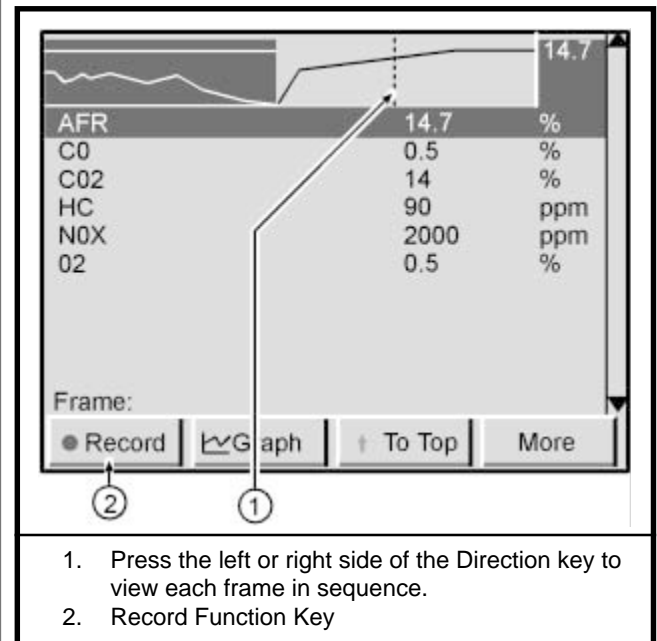
To record and playback data, follow these steps:

1. Press the RECORD Function key to instantly create a file (see Figure: Gas List). A frame will be marked with the number zero. 74 frames of data before the zero marker (identified with a negative number) and 75 frames of data after the zero marker will be captured and placed in a file in the Playback folder.
Optional: Continue viewing live data or press MENU to return to the Application Manager Menu to playback the file.

2. If playback is desired: Select **Playback** from the Application Manager menu, and then press ENTER.
3. Select a file from the list to view, and then press ENTER (see Figure: Events to Playback).
4. Press the left or right side of the Direction key to view each frame in sequence. The vertical 'cross-hair' in the graph will move to visually indicate the exact frame for a particular point in time. The graphed data will be magnified when the cross-hair moves across each frame.

You can also scroll up or down in the recorded file to select different gases to graph, simply highlight the gas and press the Graph function key.

5. Press EXIT when finished viewing the recorded data.



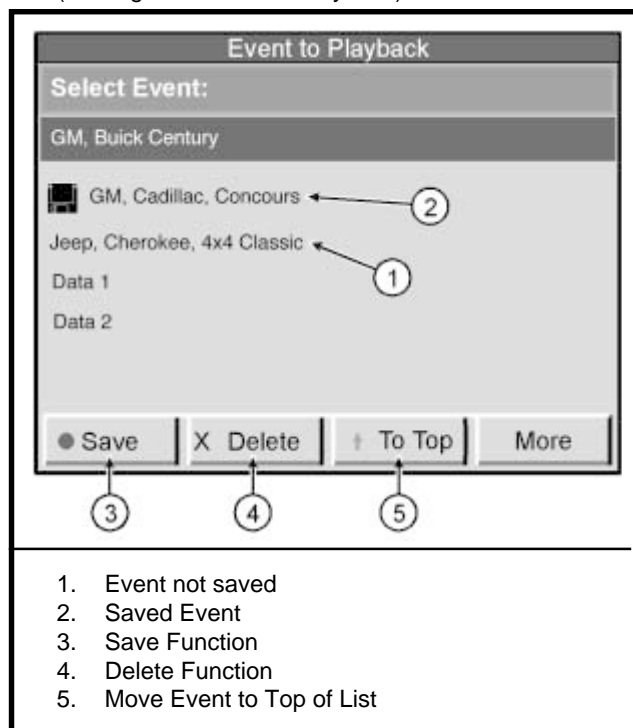
1. Press the left or right side of the Direction key to view each frame in sequence.
2. Record Function Key

Figure: Gas List

Save a Recorded File

To save a recorded file, follow these steps:

1. Press MENU to go to the Application Manager Menu, select **Playback**, and then press ENTER.
2. Select the event file, and then press the SAVE Function key. A disc icon will appear to the left of a saved file (see Figure: Events to Playback).



1. Event not saved
2. Saved Event
3. Save Function
4. Delete Function
5. Move Event to Top of List

Figure: Events to Playback

Delete a Recorded File

To delete a file, select the event file, and then press the DELETE Function key (see Figure: Events to Playback).

AVERAGE MASS

The Average Mass function calculates the average grams per mile for each gas.

To calculate an Average Mass of the Gases

To calculate the Average Mass of the exhaust gases, follow these steps:

1. Press the RECORD key to create a recording of the time period to be analyzed.
2. Select **Gas Analyzer Functions**, and then select **Average Mass** from the menu.
3. Select a recorded event from the list of recorded gas events presented, press the function key labeled **OK** to continue.
4. Select the range of frames in the recording over which you want to determine the average mass of the gases. Begin with placing the cursor on the Start Frame, then scroll up or down to select the number of the beginning frame (see Figure: Average Mass Calculation).
5. Scroll down to End Frame and set the number of the ending frame of the range to be measured.
6. Scroll down to MPG Value and set an estimated average of miles per gallon the vehicle achieved during the time the recording was performed. Press the function key labeled **OK** to calculate.

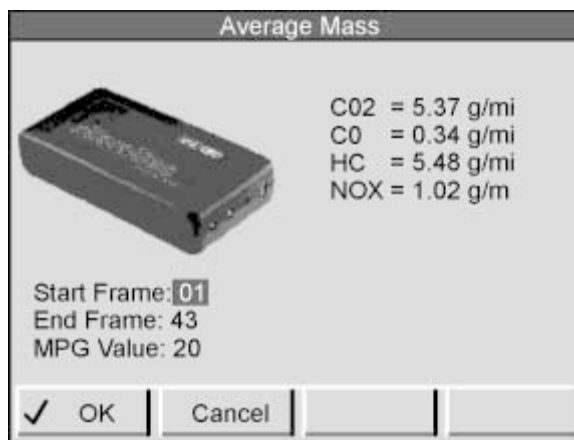


Figure: Average Mass Calculation

Calibration and Maintenance

Calibration Procedures

A number of calibration functions are required to maintain accurate gas analysis:

- **Zero** – a “set up” test that samples air that is free of exhaust or chemical fumes to establish a base set of gas ratios before vehicle testing.
- **Calibrate** – a setup that allows an adjustment of the MicroGas to calibration standards
- **Read Calibration Gas** – sample a precise ratio of test gas to determine if the MicroGas Analyzer is within calibration limits
- **Show PEF** – Propane Equivalency Factor (PEF) inspection screen

ZERO

The Zero procedure clears the analyzer hose and measurement devices of residual gases. The Zero procedure is activated automatically before testing or may be activated on demand when selected from a Function key (F4-More → Zero) or from the Gas Analyzer Functions menu (Gas Analyzer Functions → Zero). Follow the on-screen instructions to complete the Zeroing function.

Important: The “zeroing” test must sample air that is free of exhaust or chemical fumes to establish a base set of gas ratios before testing. Place the Sampling Probe about two feet above the floor and away from exhaust gas or chemical fumes.

CALIBRATE

It is necessary to calibrate the MicroGas Analyzer NOx sensor every 20 hours and the O2 sensor every 250 hours. A maintenance schedule tracks time of use and will notify you when calibration is required. If you suspect inaccurate readings, you may compare the MicroGas calibration to a precision test gas, then calibrate if necessary (see “Read Calibration Gas”). Precision test gas is required for this test and is available from your OTC distributor (OTC P/N 3700-25).

How to Calibrate the MicroGas Analyzer

1. Select **Gas Analyzer Functions** from the MicroGas Control Menu, and then select **Calibrate**. The Gas Analyzer will “zero”, or clear residual gases from the hose and analyzer.
2. Connect the Sampling Inlet Hose to the pressure regulator on the Precision Calibration Gas canister. **Important:** To prevent damage to the MicroGas Analyzer, a pre-set pressure regulator (OTC P/N 236906) must be connected between the MicroGas Analyzer and the Precision Calibration Gas canister.

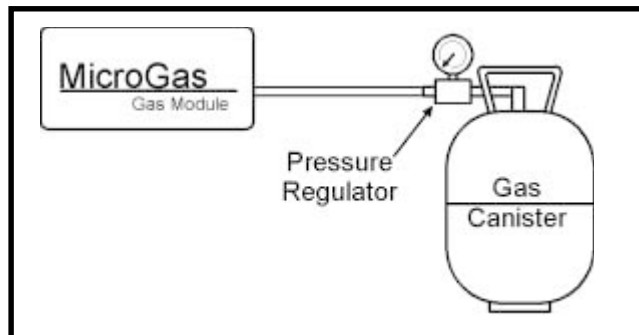


Figure: Precision Calibration Gas

Warning:

Use the Precision Calibration Gas in a well ventilated area. The fumes may cause nausea or headache.

3. Open the gas valve on the Precision Calibration Gas canister.

- If the calibration procedure continues for more than one minute, recalibrate to the factory default by pressing the function key labeled **Reset**.

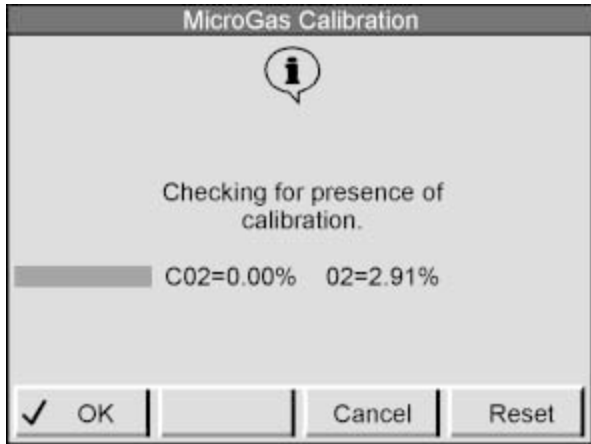


Figure: Calibration

- Enter the gas concentrations listed on the Precision Calibration Gas label into the gas values area on the Calibration screen. Move the cursor to the gas concentration %, and then press up or down to scroll the value until it matches the concentration value shown on the gas label. Press the Function key labeled OK to set the values entered.

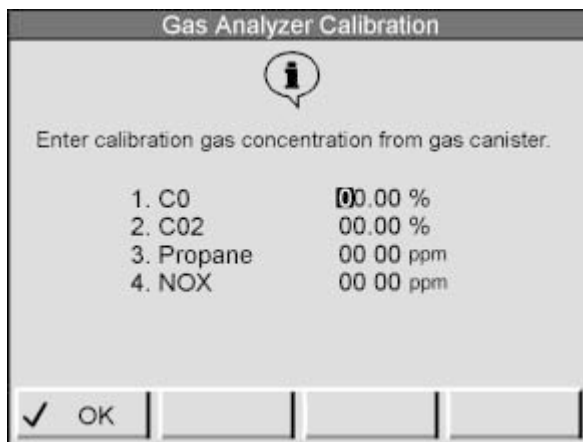


Figure: Calibration Values

If calibration fails:

- check hoses and connections for leaks
- is there test gas in the canister
- let the analyzer warm up for approximately 30 minutes
- move the analyzer to a warmer area if you are in cold surroundings
- If three failures occur, call Technical Service at 1-800-374-4427.

- Reset the maintenance schedule when a gas has been calibrated. To go to the Maintenance Schedule, select **Customer Service Information**, and then select **Maintenance Schedule**.



Figure: Maintenance Schedule

- Select the gas calibrated, then move the cursor over to the column labeled "Hrs. Since". Press the function key labeled **Reset**. The value will be reset to show how many hours remain until the gas must be calibrated again.

READ CALIBRATION GAS

If you suspect inaccurate readings, you may compare the MicroGas calibration to a precision test gas, then calibrate if necessary. Precision test gas is required for this test and is available from your OTC distributor (OTC P/N 3700-25).

How to Read Calibration Gas

1. Select **Gas Analyzer Functions** from the MicroGas Control Menu, and then select **Read Calibration Gas**. The Gas Analyzer will “zero”, or clear residual gases from the hose and analyzer.
2. Connect the Sampling Inlet Hose to the pressure regulator on the Precision Calibration Gas canister.
Important: To prevent damage to the MicroGas Analyzer, a pre-set pressure regulator (OTC P/N 236906) must be connected between the MicroGas Analyzer and the Precision Calibration Gas canister.

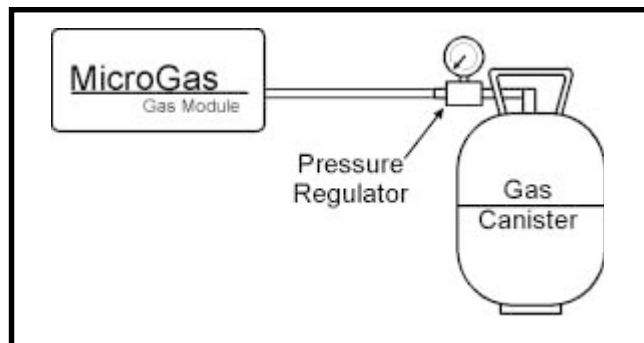


Figure: Precision Calibration Gas

Warning:

Use the Precision Calibration Gas in a well ventilated area. The fumes may cause nausea or headache.

3. Open the gas valve on the Precision Calibration Gas canister.
4. The MicroGas Analyzer is in calibration If the gas values displayed on screen match the gas values listed on the Precision Calibration Gas canister. Recalibrate the MicroGas if the values do not match, see “Calibrate” in this manual.

SHOW PEF

The Propane Equivalency Factor (PEF) inspection screen is viewed for inspection only. All adjustments for propane are automatically set when propane is selected as a fuel. Further adjustment is not necessary.

Maintenance Procedures

A number of maintenance functions are required or available to maintain accurate gas analysis:

- **Maintenance Schedule** – a “tracking” screen that alerts the user when maintenance is required
- **4/5 Gas Configuration** – a setup that allows the MicroGas to switch configuration to test four or five gases
- **Base Filter Maintenance**
- **Prefilter Maintenance**
- **Probe Tip Maintenance**
- **Sampling Hose Maintenance**
- **O2 or NOX Sensor Replacement**
- **Pump Replacement**
- **Internal Filter Replacement**
- **Sample Cell Cleaning**

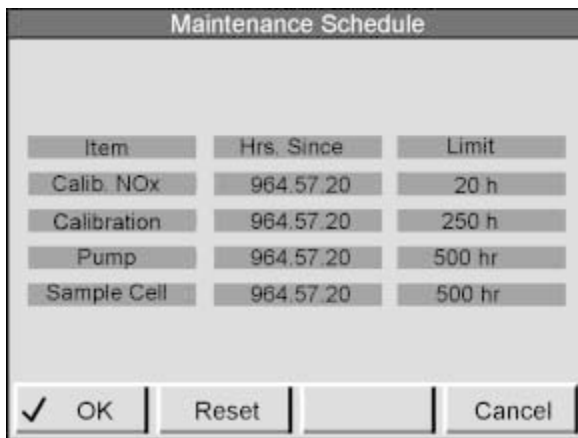
MAINTENANCE SCHEDULE

When a gas has been calibrated or a pump or sample cell replaced, the maintenance schedule must be reset. The gas or component value will be reset to show how many hours remain until the next calibration or a component must be replaced.

How to reset the Maintenance Schedule

To reset the Maintenance Schedule, follow these steps:

1. Select **Customer Service Information**, and then select **Maintenance Schedule**.



Item	Hrs. Since	Limit
Calib. NOx	964.57.20	20 h
Calibration	964.57.20	250 h
Pump	964.57.20	500 hr
Sample Cell	964.57.20	500 hr

Figure: Maintenance Schedule

2. Select the gas calibrated or the component replaced, then move the cursor over to the column labeled “Hrs. Since”. Press the function key labeled **Reset**. The value will be reset to show how many hours remain until the gas must be calibrated or the component replaced again.

BENCH CONFIGURATION

The MicroGas Analyzer can be configured to measure 4 or 5 gases. The 4 gas configuration removes the NOX data and the need to maintain the NOX cell.

How to change to 4 or 5 gas configuration

To change the configuration, follow these steps:

1. Select **Customer Service Information**, and then select **Maintenance Schedule**.
2. Select **MicroGas 4** or **MicroGas 5**, and then press the function key labeled **OK** to set the change.

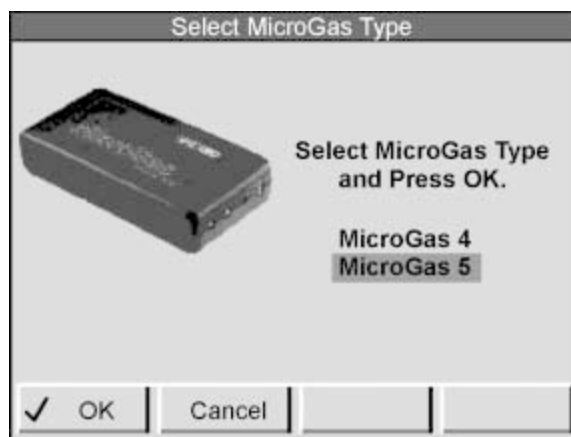


Figure: MicroGas Configuration

PREFILTER MAINTENANCE

The Prefilter acts as a water trap to help keep moisture from accumulating in the Base Filter. Any moisture accumulating in the Prefilter must be removed to prevent moisture from accumulating in the Base Filter. Replace the Prefilter if moisture is accumulating in the Base Filter or if a “Low Flow” error message is continuously received after the Prefilter has been drained of moisture.

How to remove moisture from a Prefilter

To remove moisture from a Prefilter, follow these steps:

1. Remove the Sampling Hose from the Prefilter and blow compressed air through the Sampling Hose and the probe to remove excess moisture.
2. Shake the moisture out of the Prefilter.
3. Reconnect the Sampling Hose to the Prefilter. The clear side of the Prefilter must be connected to the Sampling Hose.
4. Reconnect the Prefilter to the MicroGas Analyzer.

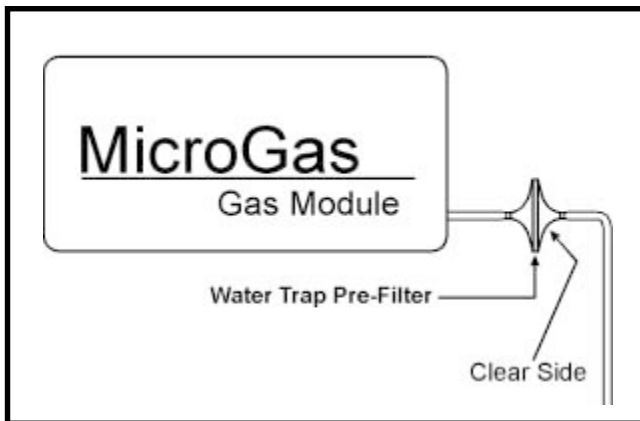


Figure: Prefilter

BASE FILTER

The MicroGas Analyzer draws outside air through the Base Filter. The moisture in the air can cause a build-up of moisture in the filter. The excess moisture must be removed from the filter. If the Base Filter is dirty, simply replace with a new filter. Replacement filters may be purchased directly from your OTC authorized tool supplier.

How to remove moisture from a Base Filter

To remove moisture from a Base Filter, follow these steps:

1. Remove the power source to de-activate the MicroGas.
2. To prevent water in the Base Filter from entering the unit, position the MicroGas Analyzer so that the back of the unit is pointed down. Remove the filter from the analyzer.
3. Wipe the analyzer Base Filter manifold dry with a clean cloth.
4. Shake the Base Filter to remove as much moisture as possible.
5. Place the Base Filter back into analyzer and hand tighten.

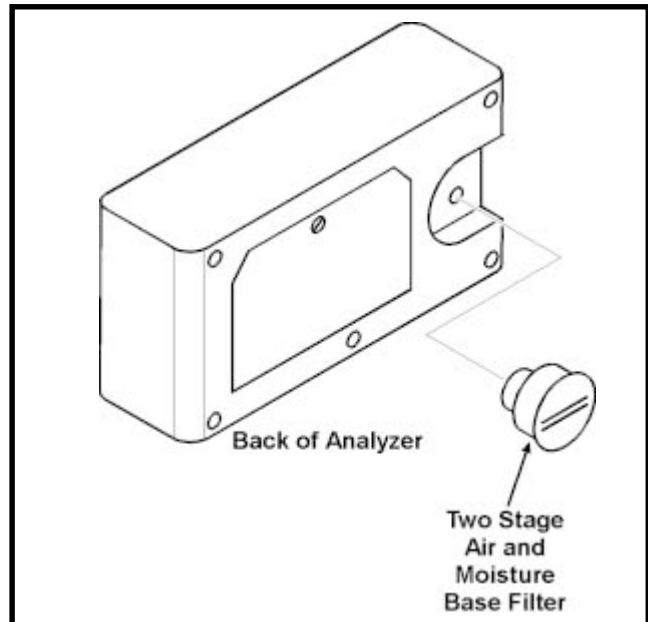


Figure: Base Filter

PROBE TIP MAINTENANCE

Check the holes in the probe tip to be sure they are not restricted. Clean with soap and water, then thoroughly air dry. **Do not use solvent-based cleaners.**

SAMPLING HOSE MAINTENANCE

Replace the Sampling Hose if there is puncture damage, kinks or anything that can cause an obstruction of air flow. The Sampling Hose may be cleaned with soap and water and air dried. **Do not use any solvent-based cleaners.** Compressed air may be used to dry out the inside of the hose.

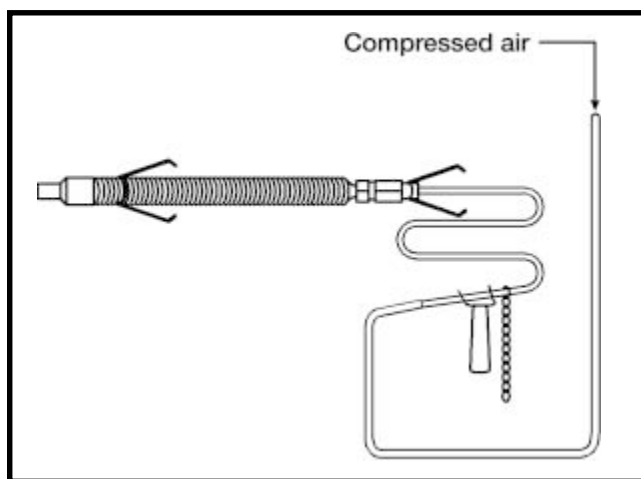


Figure: Sampling Hose Maintenance

O2 AND NOX SENSOR REPLACEMENT

The O₂ and NO_x sensors have an expected life of 18 months under normal operating conditions. When the MicroGas Analyzer cannot calibrate to the O₂ or the NO_x sensor, it will display a message requesting replacement of the O₂ or NO_x sensor. Replace the faulty sensor immediately and calibrate the analyzer.

To replace an O₂ or NO_x sensor

To replace an O₂ or NO_x sensor, follow these steps:

1. Remove the back panel from the MicroGas Analyzer.
2. Carefully pull up on the sensor pull-tab to unseat the faulty sensor from the baseplate. See Figure: O₂, NO_x Sensor Replacement
3. Position the replacement sensor so that the pins are aligned with the baseplate, and then firmly seat the sensor into the baseplate.
4. Place the back panel on the MicroGas Analyzer.
5. Perform a Calibration procedure.

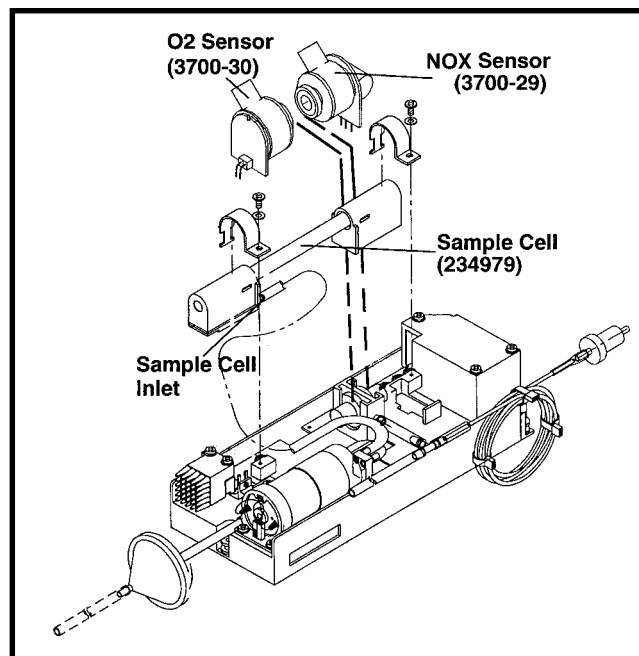


Figure: O₂ or NO_x Sensor Replacement

PUMP REPLACEMENT

The pneumatic pump in the MicroGas Analyzer has an expected life of 12 months under normal operating conditions.

To replace a damaged pump

To replace a damaged pump, follow these steps:

1. Remove the back panel from the MicroGas Analyzer.
2. Remove the screws that secure the pump to the baseplate. See Figure: Pump or Internal Filter Replacement.
3. Carefully pull up on the connector end of the pump housing to unseat the connector pins from the subassembly board.
4. When the connector pins are clear of the subassembly board, pull the pump out of the hose connector manifold.

Note: If an old style pump is in the unit, disconnect the hoses from the pump and connect the internal filter and the hose to the hose manifold as shown in Figure: Pump or Internal Filter Replacement. The internal filter and the hose are supplied with the replacement pump or are available separately. If additional hose is required, cut the hose from the hose/probe assembly.

5. To install the new pump, begin by connecting the pump inlet/outlet connections with the hose connector manifold.
6. Push the pump firmly into the hose connector manifold and align the pump connector pins with the pump connector in the base plate.
7. When the connector pins are aligned with the pump connector in the base plate, push down firmly to seat the connector pins into the base plate.
8. Apply pressure to the pump to hold it firmly against the hose connector manifold. Tighten the two pump mounting screws to two (2) inch-pounds. **Important:** do not over-tighten the pump mounting screws.
9. Place the back panel on the MicroGas Analyzer.
10. Perform a Calibration procedure.

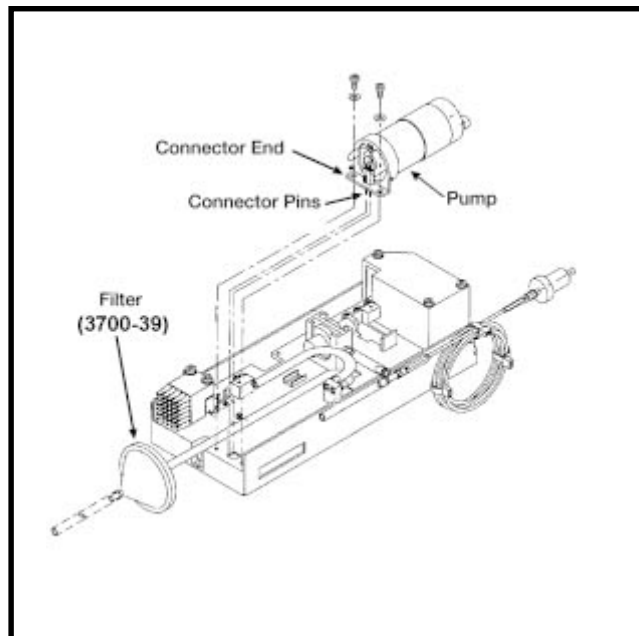


Figure: Pump or Internal Filter Replacement

INTERNAL FILTER

If the MicroGas Analyzer continually reports a "low flow error," the Internal Filter may be full of moisture and require replacement. The Internal Filter should be replaced every 12 months or when moisture has accumulated inside the Filter.

To replace an Internal Filter

To replace an Internal filter, follow these steps:

1. Remove the back panel from the MicroGas Analyzer.
2. Refer to Figure: Pump or Internal Filter Replacement. Replace the Internal Filter with the flat side positioned toward the pump inlet as illustrated. Be sure the hoses are also oriented as illustrated.
3. Place the back panel on the MicroGas Analyzer.

SAMPLE CELL CLEANING

The sample cell should be removed and cleaned every 12 months under normal operating conditions.

To clean a sample cell

To clean a Sample Cell, follow these steps:

1. Remove the back panel from the MicroGas Analyzer.
2. Refer to Figure: Sample Cell Cleaning. Remove the hose connected to the Sample Cell inlet, and then remove the Sample Cell clamp screws.
3. Carefully lift up on the Sample Cell to unseat the assembly from the baseplate (Do not dislocate the four O-rings located under the sample cell).
4. Separate the end caps from the glass cell tube.
Important: Be careful, the cell tube is very fragile.
5. Clean the cell shaft and end-cap windows using cleaning kit 234977 (available from your OTC distributor).
6. When the Sample Cell and end-caps are dry, install the end-caps onto the Sample Cell.
7. Position the Sample Cell onto the baseplate, be careful to align the baseplate fittings. Be sure the four O-rings are in place, and then push down gently on the cell to seat the assembly.
8. Install the Sample Cell retaining clamps with screws and torque to two (2) inch-pounds. Connect the pump outlet hose to the sample cell inlet.
9. Place the back panel on the MicroGas Analyzer.
10. Perform a Calibration procedure.

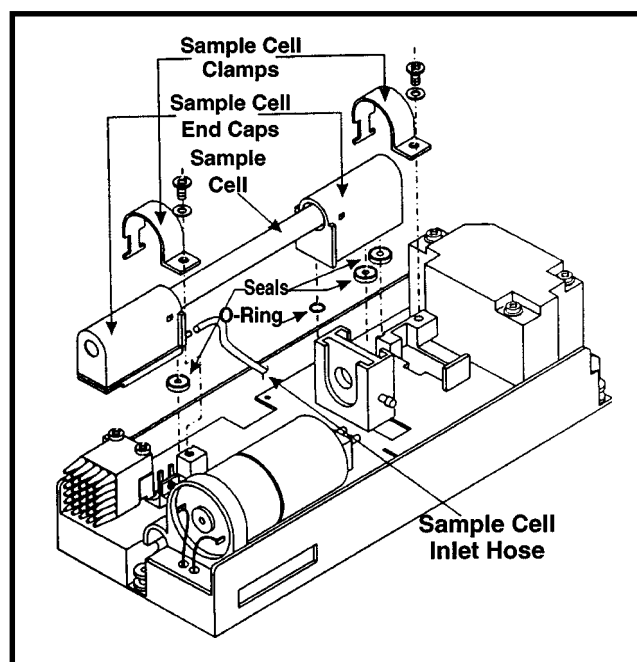


Figure: Sample Cell Cleaning

Troubleshooting Procedures

MICROGAS SYSTEM CHECK

When a problem is suspected with the MicroGas Analyzer, conduct a three point system check with the following tests:

1. Press the scan tool power key to turn the tool Off, and then press the power key again to turn the scan tool On. Select **Gas 2000** from the Application Manager menu to restart the MicroGas Analyzer. If pass, go to the next system check. If the analyzer does not start, call SPX Technical Help at 1-800-533-6127.
2. Activate the Zero Procedure (Select **Gas Analyzer Functions**, select **Zero**). If pass, go to the next system check. If the procedure fails, check the following potential trouble areas:
 - When activating the Zero Procedure, keep the probe three feet above the floor to avoid sampling residual gases.
 - Drain any moisture from the Prefilter and the Base filter. Replace any filter if it is dirty or contaminated with oil, diesel fuel, gasoline, antifreeze, or excess water.
 - The Sampling Inlet Hose, Sampling Probe and internal sampling path may need to be air dried if the MicroGas Analyzer has been exposed to a high moisture condition.
 - Remove the Sampling Inlet Hose and the Sampling Probe from the MicroGas Analyzer. Thoroughly clean the hose and the probe with soap and water. Dry the hose and probe with compressed air. **IMPORTANT:** Do not blow compressed air into the MicroGas Analyzer.
 - Replace the Sampling Inlet Hose and the Sampling Probe if they become heavily saturated with gas, oil, or solvents. The hose may also be contaminated if a vehicle has been tested that had aftermarket fuel additives added to the fuel.
 - Inspect the internal hoses, internal sample cell, pump or manifold for contamination with oil, diesel fuel, gasoline, antifreeze, or excess water. Replace any component saturated with any contaminant.Eliminate or repair all potential trouble areas as described, activate the Zero Procedure again. If the procedure fails again, call SPX Technical Help at 1-800-533-6127.
3. Activate the Calibration Procedure (Select **Gas**

Analyzer Functions, select **Calibrate**). If this procedure and procedures 1 and 2 passed, the MicroGas Analyzer system is good. Review your gas testing procedures to determine if all test procedures are done correctly. If the procedure fails, check the following potential trouble areas:

- Check the Sampling Inlet Hose for cracks, pinholes or kinks. Check all calibration tank couplings for leaks.
- Check if the calibration gas concentrations are correctly entered into the MicroGas Analyzer Calibration program.
- Check if the valve at the calibration tank is turned on.
- Check if calibration gas cylinder is empty.

Eliminate or repair all potential trouble areas as described, activate the Calibration Procedure again. If the procedure fails again, call SPX Technical Help at 1-800-533-6127.

LOW FLOW ERROR

When a Low Flow error is constantly received, check the following potential trouble areas:

- Disconnect and inspect the entire Sampling Inlet Hose, Sampling Probe and internal sampling path for obstructions, kinks or damaged couplings.
- Inspect the Two Stage Air and Moisture Base filter gasket for any breaks that could cause an air leak.
- Drain any moisture from the Prefilter and the Two Stage Air and Moisture Base filter. Replace any filter if it is dirty or contaminated with oil, diesel fuel, gasoline, antifreeze, or excess water.
- Inspect the internal hoses, internal sample cell, pump or manifold for contamination with oil, diesel fuel, gasoline, antifreeze, or excess water. Replace any component saturated with any contaminant.

Note: If you find the internal filter filled with contaminant, call Technical Service at 1-800-533-6127.

SUDDEN SPIKES IN THE EXHAUST GAS READINGS

Occasionally, Radio Frequency Interference (RFI) from a very powerful transmitter for cellular telephones or 2-way radios will cause an electrical signal spike. Relocate the signal source or wait until it is out of range.

Appendix

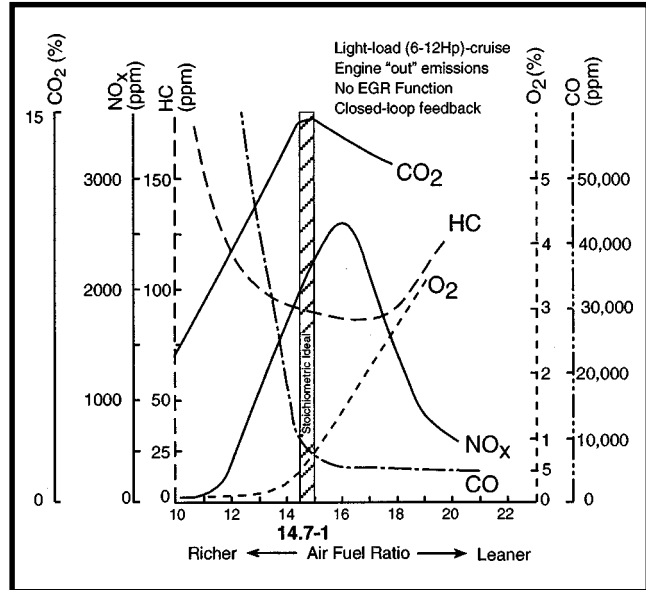
Emissions Gas Analysis

Combustion occurs when a spark is applied to gasoline mixed with air. If the ratio of gasoline mixed with air is one pound of gasoline to 14.7 pounds of air, the gases produced from the combustion are water (H₂O) and Carbon Dioxide (CO₂). When the ideal mix of 1 pound of gasoline to 14.7 pounds of air is changed, undesirable pollutants such as Carbon Monoxide (CO), Hydrocarbons (HC) and Oxides of Nitrogen (NO_x) are produced along with the water (H₂O) and Carbon Dioxide (CO₂).

The MicroGas Analyzer measures the five gases emitted in the exhaust stream of an internal combustion engine. Any variance in the ratio of 1 part fuel to 14.7 parts of air will produce a variance in the ratio of gases emitted. Variances may be the result of defective or poorly adjusted engine components. Each of the five gases and the air-fuel ratio must be analyzed individually and together to determine what may be causing an unacceptable level of pollutant gases.

AIR FUEL RATIO

The ideal air to fuel ratio (AFR) of 14.7 pounds of air to one pound of fuel is called the Stoichiometric point. When this ratio is achieved, ideal combustion occurs and the gas ratios will appear at the levels illustrated in the chart labeled Stoichiometric, Measured Air-Fuel Ratio. An acceptable air to fuel ratio range is between 14.6 to 14.8



**Stoichiometric
 Measured Air-Fuel Ratio**
 ©1992 Colorado State University-NCVECS

LAMBDA

Lambda is a measurement commonly used to determine if the air to fuel ratio is rich or lean. Lambda (λ) is a single point determined by dividing the actual air to fuel ratio by the ideal air to fuel ratio (an actual 14.7 divided by an ideal 14.7 equals 1.0). An acceptable Lambda range is between 0.9 to 1.1. A Lambda less than 0.9 indicates a rich condition and a Lambda higher than 1.1 indicates a lean condition.

OXYGEN

The amount of oxygen (O₂) remaining after combustion should be 0.5%. Refer to Chart: Stoichiometric, Measured Air-Fuel Ratio. An acceptable range is between 0.2 to 1.5%. A lower O₂ level indicates a rich fuel mixture: more O₂ is consumed to burn the excess fuel. A higher O₂ level indicates a lean fuel mixture or a hole in the exhaust system which lets additional O₂ into the exhaust stream.

CARBON MONOXIDE

Carbon monoxide (CO) is the by-product of incomplete combustion. The amount of CO remaining after combustion should be 0.5%. Refer to Chart: Stoichiometric, Measured Air-Fuel Ratio. An acceptable range is between 0.2 to 1.5%. A higher CO level indicates a rich fuel mixture: there isn't enough oxygen to burn the excess fuel.

Tip: A gasoline engine is operating efficiently and within an acceptable emissions range when carbon monoxide and oxygen are equal to each other and within a range of 0.2 to 1.5%.

OXIDES OF NITROGEN

Oxides of nitrogen (NO_x) is the result of excess combustion temperatures. The amount of NO_x remaining after combustion should be 2000 ppm. Refer to Chart: Stoichiometric, Measured Air-Fuel Ratio. A high NO_x level indicates an EGR valve or system not allowing recirculation, an engine operating under a high work load or a faulty catalytic converter.

CARBON DIOXIDE

Carbon Dioxide (CO₂) is the by-product of incomplete combustion. The amount of CO₂ remaining after combustion should be 14%. Refer to Chart: Stoichiometric, Measured Air-Fuel Ratio. A higher CO₂ level indicates an engine running at a very efficient level.

HYDROCARBON

Hydrocarbon (HC) is the by-product of incomplete combustion. The amount of HC remaining after combustion should be 90 ppm. Refer to Chart: Stoichiometric, Measured Air-Fuel Ratio. A higher HC level indicates unburned fuel in the exhaust stream. The excess HC may be caused by spark plug misfire, any rich or lean fuel mixture, ignition fault or a mechanical problem.

Specifications

The MicroGas Analyzer is a hand-held test unit that provides real-time measurement of gases found in gasoline-powered vehicle exhaust.

This analyzer will meet or exceed national measurement accuracy standards for automotive exhaust analyzers in the United States and Europe. These standards include:

- BAR97, BAR 90, BAR 84, BAR 80, EPA 207B (USA)
- P.T.B. (West Germany)
- S.I.M. (France)
- Department of Metrology (Switzerland)
- IJKWEZEN (Netherlands)
- O.I.M.L. Class 0 (International)

Measurement Ranges

- Hydrocarbons (HC): 0-30,000 ppm
- Carbon Monoxide (CO): 0-15%
- Carbon Dioxide (CO₂): 0-20%
- Oxygen (O₂): 0-25%
- Oxides of Nitrogen (NOx): 0-5000 ppm

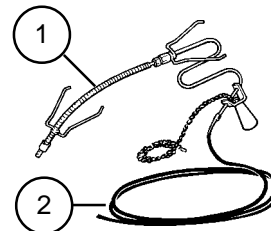
Environment

	<u>Operating Range</u>	<u>Storage Range</u>
• Temperature:	32 to 113° F (0 to 45° C)	-20 to 140° F (-28 to 60° C)
• Humidity:	15 to 85% RH (non-condensing)	0 to 95% RH (non-condensing)
• Altitude:	-1,000 to +7,000 ft.	-1,000 to +10,000 ft.

Replacement Parts



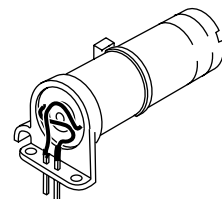
Calibration Gas
(3700-25)



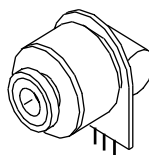
1. Sampling Probe (3700-27)
2. Sampling Inlet Hose (3700-26)



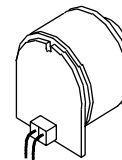
Base Filter - 10 pack
(3700-28)



Pump
(234978)



Nox Cell
(3700-29)



O₂ Cell
(3700-30)



Internal Filter
(3700-39)



Prefilter - 10 pack
(3700-36)

Not illustrated:

Cleaning Kit -----	234977
Annual Maintenance Kit - 10 Base filters, 10 Pre-filters, 3 Internal filters plus Cleaning kit -----	234980
Calibration Hose -----	236406
Exhaust Outlet Hose -----	236407
Regulator -----	236906

SPX CORPORATION LIMITED WARRANTY OTC GAS MONITOR

THIS WARRANTY IS EXPRESSLY LIMITED TO ORIGINAL RETAIL BUYERS OF SPX'S OTC GAS MONITORS ("ANALYZERS").

SPX Analyzers are warranted against defects in materials and workmanship for eighteen (18) months from date of purchase, except for the following items which are warranted for six (6) months from date of purchase: Sample Cell, O2 Sensor, NOx Sensor, and Pump. This warranty does not cover the following replaceable items, which have a finite life dependent upon frequency and type of use: Particle Filters, and Probe/Hose Assembly.

This warranty does not cover any Analyzer that has been abused, altered, worn out, damaged due to improper use, or contaminated from improper filtration. The sole and exclusive remedy for any Analyzer found to be defective is repair or replacement, at the option of SPX. In no event shall SPX be liable for any direct, indirect, special, incidental or consequential damages (including lost profit) whether based on warranty, contract, tort or any other legal theory. The existence of a defect shall be determined by SPX in accordance with procedures established by SPX. No one is authorized to make any statement or representation altering the terms of this warranty.

DISCLAIMER

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING ANY FITNESS FOR A PARTICULAR PURPOSE.

SOFTWARE

Analyzer software is proprietary, confidential information protected under copyright law. Users have no right in or title to Analyzer software other than a limited right of use revocable by SPX. Analyzer software may not be transferred or disclosed without the written consent of SPX. Analyzer software may not be copied except in ordinary backup procedures.

ADDITIONAL EXCEPTIONS TO WARRANTY

SPX Analyzers are designed to analyze exhaust emissions of internal combustion engines which are not fueled by diesel or operated in "loaded mode." The gas presented to the analyzer must be pre-conditioned per SPX's specifications. Damage caused by improper use or contamination from improper filtration WILL NOT BE COVERED UNDER WARRANTY.

SPX reserves the right to charge the buyer for replacement of any contaminated internal component if such contamination is determined by SPX to be due to (1) failure to properly service customer-replaceable in-line filters, or (2) operation in a manner inconsistent with the Analyzer's intended use or instructions regarding use. A fixed charge for replacing the contaminated internal components will be provided at time of replacement.

ORDER INFORMATION

Replacement and optional parts can be ordered directly from your SPX authorized tool supplier. Your order should include the following information:

1. Quantity
2. Part number
3. Item description

Technical Service

If you have any questions on the operation of the product, please call: **(800) 533-6127**

Repair Service

When sending your SPX electronic product in for repair, please include the following information:

- company name
- contact name
- telephone number
- description of the problem
- proof-of-purchase for warranty repairs
- preferred method of payment for non-warranty repairs

Payment can be made with Visa, Master Card, COD, or with approved credit terms. To receive a credit application, please fax your request to Credit Department at 800-962-8734.

Send the unit to:
SPX Corporation, Owatonna Facility
2300 Park Drive, Owatonna, MN 55060
Attn: Repair



*Owatonna, MN 55060-1171
Phone: 507-455-7000. Fax: 507-455-7106
Customer Service: 1-800-533-6127
Customer Service Fax: 1-800-283-8665
Technical Services: 1-800-533-6127
Technical Services Fax: 1-800-955-8329
International Sales: 507-455-7290
International Sales Fax: 507-455-7059*

Internet: <http://www.otctools.com>

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