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### **Technical Data**

Power: Ranges:	10 -16 VDC HC: 0 - 2000 ppm (0-20,000 ppm High Range) CO: 0 - 10% CO2: 0 - 20% O2: 0 - 25% NO: 0 - 5000 ppm ( Nitric Oxide ) *							
Warm up:	Less than 5 minutes							
Display resolution: HC: 1 ppm vol.								
	CO: 0.01% vol.							
	CO2: 0.1% vol.							
	O2: 0.01% vol.							
	NO: 1ppm*							
Digital display:	Four 0.5" LCD							
Accuracy (Bar 97 EPA ASM) HC: 4 ppm HC CO: 0.06% CO								
	CO2: 0.3% CO2							
	O2: 0.1% O2							
	NO: 25 ppm*							
Drift: Zero and span drift are less than $\pm 0.6\%$ of full scale for the first hour and less than $\pm 0.4\%$ of full scale per hour thereafter.								
System response time: Bench: 1.5 Sec/25 ft. hose 5 sec. to 90% of final reading Ambient conditions: 35F (2C) to 120F (45C) rel. humidity 0-98%								
Sample hose: 25 feet (7.5 m) with QD coupling /200 F Degrees Ma								
Sample probe: Mass:	Approx.: 10 LBS. ( 4.5 Kg )							

# **General Information**

Congratulations on your purchase of an EMS Exhaust Gas Analyzer. This product is designed to assist you in the process of diagnosing driveability issues. With proper care and maintenance this product will provide accurate information for many years to come.

Figure 1 highlights the features and buttons available on the Model 5001 front display area. If you purchased a 4-Gas analyzer the **"O2/NOX"** button is inactive. The "Z", "P" and "C" buttons will be described in detail later in this manual.

IMPORTANT NOTE: Moisture is the biggest concern for prolonged good operation of the gas analyzer, always allow the analyzer to dry out by running the unit with ambient air. This may take only one auto shut down cycle or as much as 1 hour or more! The analyzer will not be harmed by powering up and letting it sit in standby mode till ready to use. Running the analyzer with ambient air in-between sampling and after a day of testing, is the best thing to do for prolonged life of the bench and components not allowing the carbon build up due to moisture!



Figure 1



## **Rear Panel Description**



Figure 4

Figure 4.1

Figure 4 shows the view from the back of the analyzer. The specific details of each item are described below, starting from the upper left corner of the analyzer and working clockwise. NOTE: Fig 4 shows the OLD filtration system that has been discontinued. Fig. 4.1 shows the NEW filtration system, EMS-5370-Assy.

**Sample Hose Connection:** The sample hose connection uses a quick disconnect coupler. The is helpful for storage of the analyzer and maintenance of the sample hose. **Display Control Switch:** The display switch has two basic positions, Computer and Display. The switch should normally be in the lower position "Display". If you are using PC software for display or recording, the switch should be in the up position. *Note: If the analyzer is not displaying gas values after warm-up, the display switch may be in the computer position.* 

Computer Connection: This is used to connect the analyzer to the PC. Power Cord: Connect to the appropriate voltage supply source. Fresh Air Port: The analyzer uses this for fresh air sampling. Do not plug. Drain Hose: This hose will drain moisture collected during the sample process. External Filter: This is the primary sample filter. Filter maintenance will be discussed in the Maintenance section of this manual. Fig 4.1 shows NEW filtration system.

Printer Connection: Connect to an approved parallel printer.

## **Gas Analyzer Preparation**

Getting started is simple. Figure 5 shows the items you should have received in the shipping container. Note: This description applies to the Model 5001 analyzer with a display, see Page 13 for instructions on setting up a Model 8000 bluetooth wireless analyzer. The first step is assembling the sample hose. Once the sample hose is assembled, connect the hose to the sample hose fitting on the back of the analyzer.



The next step is providing power to the analyzer. The analyzer should be connected to a 12v DC power source. You have several options:

- 1. Cigarette Lighter Connection Figure 6
- 2. Cigarette lighter to battery connection with adapter Figure 7
- 3. AC to DC Power Supply Figure 8 EMS-5256







Figure 6

Figure 7

Figure 8

The Power LED in the lower left corner of the display will light once voltage is applied.

# **Gas Analyzer Operation**

Immediately after applying power, the analyzer will display 8's (Figure 9) for a few seconds and then flash dashes (Figure 10). This starts the analyzer warm-up mode and will continue for approximately 5 to 10 minutes, depending on ambient temperature. Once the warm-up mode is complete, the analyzer will go into the gas sample mode (Figure 11) and the Sample LED will turn ON. *Note: If the display only shows decimal points (Figure 12), check the "Display/Computer" switch on the back of the analyzer. The switch should be in the display position. Disconnect power before changing the switch position.* 



Figure 11

Figure 12

Once the analyzer has completed the warm-up process the sample hose can now be connected and the probe placed in the tailpipe.

Caution: Exhaust gases pass through the gas analyzer and vent through its exhaust tubing. Use the analyzer in a well vented area.

Note: Gas analyzers are designed for diagnostics and verification of repairs. The sample probe should be removed from the tailpipe after taking readings to prolong analyzer life and save on maintenance costs.

The pump will continue to operate as long as the CO2 level is above 3%. The pump will automatically shut-off after the CO2 level has been below 3% for approximately 15 minutes. The pump can be turned back on by depressing the "**Z**" button.

Caution: Monitor the clear hose between the filter assembly and the cabinet. If moisture appears in the tubing, remove the probe from the tailpipe and disconnect the sample hose from the analyzer immediately. Use compressed air to remove moisture from the sample hose. Operate the analyzer without the exhaust hose connected, until the moisture is removed. It may be necessary to replace the filters. Once the lines are dry, normal operation can continue.

# **Gas Analyzer Operation**

**Manual Zero:** Any time after warm-up, you can zero the gas readings and calibrate O2 by pressing the "**Z**" button. If the pump is off, it will automatically start. *Note: The sample probe should be removed from the tailpipe, when the unit is being zeroed.* 

Automatic Zero: The analyzer will automatically zero as needed. If the analyzer does not sense exhaust gases, the automatic zero procedure will begin. The Sample LED will flash during this process. If exhaust gases are present, the analyzer will wait until the gases are clear.

**Low Flow Warning:** If gas flow into the bench becomes restricted due to clogged filters or restricted sample hose, the "**HC**" display will show "**LO**" (Figure 13). The other gas displays will be blank. Check the sample hose for restrictions or kinks. If no problems are found, check the filters. Begin with the External filter and then check the Internal filter. Keep in mind the gas flows through the inside to the outside of the filter. The filter may look clean on the outside, but be clogged on the inside.



Figure 13

**Printing:** Connect a parallel printer to the 25 pin connector on the back of the analyzer. Press the "P" button to begin the printing process. *Note: To avoid print communication problems, connect and power on the printer first, then provide power to the analyzer.* 

**Computer Connection:** PC software can enhance the diagnostic benefits of the analyzer. The analyzer can be connected to a PC using a 9 pin serial communications cable. EMS offers software that will display the sample gases, graph data and record information. Using the portable gas analyzer with a laptop will help diagnose problems that only occur when driving. The EMS software will be discussed later in this manual.

# **ERROR CODES**

**O2 Sensor Error Code:** Any time after warm-up, you can get a O2 sensor error code that will be shown with an "E" in the CO window, and a number "800" in the O2/NOX window. When this error message is displayed, a new O2 sensor needs to be installed. See maintenance for the O2 sensor replacement.

**NOX Sensor Error Code:** Any time after warm-up, you can get a NOX sensor error code that will be shown with an "E" in the CO window, and a number "1000" in the O2/NOX window. When this error message is displayed, a new NOX sensor needs to be installed. See maintenance for the O2 sensor replacement.

**Optical Bench Error Codes (HC,CO,CO2):** Any time after warm-up, you can get an error code that will be shown with an "E" in the CO window, and a number "100" in the O2/NOX window indicates HC out of range, "200" in the O2/NOX window indicates CO out of range, "400" in the O2/NOX window indicates "CO2" out of range. When this error message is displayed, the analyzer MUST be sent to EMS for a bench diagnosis. Please send the unit to 801 N. Harrison St., Algonquin IL. 60102, and indicate in writing what the error code is that occurred.





## Calibration

The gas analyzer should be checked periodically for accuracy. EMS recommends the analyzer be re-calibrated every 6 months minimum for a 5 gas unit The analyzer can be calibrated in the field. In order to perform the calibration procedure you will need a bottle of calibration gas and a calibration kit assembly (Figure 14). The calibration assembly can be purchased from EMS or your local distributor. The recommended calibration gas is Bar 97 Low and can be purchased from EMS or a local specialty gas supplier. Calibration Procedure:

1. To begin the calibration procedure depress the "Z" and "C" buttons together. *Note: If the "C" button is pushed too late the analyzer will begin the zeroing procedure. If this occurs, wait until the zero procedure is complete and try again.* The analyzer display will go blank if the buttons are depressed properly. Release the buttons and the display will show the stored calibration gas values. Compare these numbers to the calibration gas bottle. If the numbers do not match, they can be changed using the "Z" and "C" buttons. The "C" button will change the number that is flashing. Once the flashing number is adjusted to the correct value, the "Z" button is be used to cycle to the next digit. This process is continued until all the calibration gas values are correct. Note: The NOx gas concentration value is displayed in the 02 window.

2. Once the calibration gas values have been verified or adjusted, the calibration procedure can continue. Depress the "Z" and "C" buttons together. The analyzer display will go blank. Release the buttons and the analyzer will begin the calibration sample mode. The display will show current sample values and then display dashes.

3. Connect the hose from the regulator assembly to the sample hose inlet. Open the valve on the gas bottle. (**Note: Do not adjust the regulator, this was preset to the appropriate flow value.**) Once the calibration gas values stabilize, depress the "C" button. The analyzer will capture the gas concentrations and perform the final calibration procedure. The calibration process is now complete.

4. If the calibration procedure was unsuccessful, error numbers will flash along with the sample numbers. If this occurs, perform the calibration procedure again. If the problem continues, contact EMS or your local distributor. **NOTE:** The hydrocarbon gas in the calibration cylinder is propane, and the gas analyzer generally measures hexane. This is problematical, as hexane is a molecule that is about twice as large as propane. This means that the typical HC reading on the gas analyzer (hexane) should be about ½ the propane value on the calibration cylinder tag. That is, if the tag states that the cylinder contains 1200 ppm propane, then an analyzer measuring HC as hexane will report HC at about 600 ppm.

Figure 14 11





Maintenance of the analyzer is essential for accuracy and optimal performance. The filters, hoses and connections should be checked on a regular basis. Maintenance of the gas analyzer is simple and only requires a few minutes, but the time you spend will pay off, with accuracy during the diagnostic process. Specific maintenance procedures are described below:

#### **External Analyzer Maintenance:**

1. The exhaust sample hose should be cleaned once a week (Figure 15). Disconnect the hose from the filter assembly and blow shop air through the hose. This will remove carbon, dirt and moisture that collects inside the hose. The exhaust probe tip should be checked for leakage around the flex tube. Exhaust gas should only enter through the holes in the exhaust tip end. If the flex tube is worn and loose, oxygen may enter around the worn flex tube. A simple way to check the flex tube is blowing shop air through the hose and spraying soapy water around the flex tube. If bubbles are seen the exhaust probe tip should be replaced. The sample hose and plumbling should be checked for leaks. Checking for leaks is simple, with the analyzer in sample mode, place a rubber cap over the probe tip holes. Within a few seconds the analyzer display should read low flow. If this does not occur a leak is present in the system. Check the sample hose for leaks first, check the external filter next and finally the internal hoses. Contact EMS or your local distrubutor for assistance if required.

2. The External Filter should be checked often (Figure 16). This filter catches most of the particles and impurities. The life-cycle of this filter depends on usage, but the average shop replacement is 3-6 months. To determine the correct replacement interval for your shop, check the filter once a month. Keep in mind the exhaust gas flows from the inside of the filter to the outside on the water trap bowl so the filter may look good on the outside, but be plugged on the inside.flow from the outside in on the particulate bowl. To check the condition of the filter, disconnect the water pump hose, unscrew the filter bowl, and unscrew the filter retainer screw.

#### **Filter Replacement:**

- a. Disconnect the water pump hose from the bottom of the filter bowl.
- b. Rotate the filter bowl counter-clockwise to remove.
- c. Rotate the filter retainer screw counter-clockwise to remove.
- d. Re-install the filter (new) assembly clockwise hand tight.



Figure 15

Figure 16

#### Internal Analyzer Maintenance:

The maintenance items discussed below are located inside the analyzer. The outside cover will need to be removed to gain access. The cover is held in place with 11 screws, 5 on each side panel and one at the top behind the handle.

3. The Internal Filter is located inside the analyzer (Figure 17). This filter is designed to catch particles missed by the External Filter. The replacement interval varies, but a good starting point, is replacing the filter every other time you replace the External Filter. Note: This filter is directional, check the arrow on the filter.

4. Oxygen Sensor should be replaced as required (Figure 18). Replacement intervals will vary, but the average life-cycle is 9 to 12 months. A fault code will flash when the sensor needs to be replaced, the analyzer cannot be used until the sensor is replaced. To avoid unexpected down time, the O2 sensor display can be monitored, if the reading drops below 17.0% the O2 sensor should be replaced. The oxygen sensor is located inside the analyzer.

a. Remove the analyzer cover. Note: The power should be disconnected prior to cover removal. The sensor is located at the left rear of the analyzer (Figure 18).b. Disconnect the two wire connector from the sensor. Rotate the sensor counter-clockwise.

c. Install the new sensor, rotate clockwise until the o-ring seats. Re-connect the two wire connector. Replace the cover and power the analyzer. No additional steps are required.

5. NOx Sensor should be replaced as required (Figure 19). Replacement intervals will vary. A fault code will flash when the sensor needs to be replaced.

a. Remove the analyzer cover. Note: The power should be disconnected prior to cover removal. The sensor is located at the left rear of the analyzer (Figure 19).b. Disconnect the four wire connector from the sensor. Rotate the sensor

counter-clockwise.

c. Install the new sensor, rotate clockwise until the o-ring seats. Re-connect the four wire connector. Replace cover and power the analyzer. No additional steps are required.

Figure 17



**Internal Filter** 

Figure 18



Oxygen Sensor

Figure 19



NOx Sensor

The parts in need of consistent interval change out are the external & internal filters and the O2 sensor. The intervals, tools needed, part #'s, and other maintenance tips for instrument life are described below:

#### 1) Internal Filter; part #: EMS-5093; 90 DAY (3 month min.) Interval.

- TOOLS: 2 mm key style allen wrench, needle nose pliers, wire/zip tie strap cutter.
- Remove the 11 or 12 #6 button head screws with 2mm allen. Be careful not to strip allen head when loosening & ONLY FINGER tight when tightening.
- Remove the cover, int. filter located in the back right, cut off zip ties and use needle nose pliers to remove the hose. Install new filter and attach two (2) new zip ties on each end to ensure no LEAKS. Attach cover back on the main housing.

#### 2) External Filter; part #: EMS-5371; 90 DAY (3 month min) Interval.

- TOOLS: None required.
- External filter is located on the back side angle bracket, remove the filter bowl from the filter head, turn clockwise to loosen and remove.Loosen the retainer holding the filter turning clockwise. replace the filter, screw filter retainer counter-clockwise to tighten. Make sure the filter goes on straight, this is the most common point for leaks! Screw on filter bowl turning counter-clockwise. Do a leak check after any filter change.

# 3) O2 Sensor; part #: EMS-5060; 12-18 month (1-1 1/2 Year) Interval or ERROR code O2 E800 error code model 5001.

- TOOLS: 2 mm key style allen wrench
- Remove the 11 or 12 #6 button head screws with 2mm allen. Be careful not to strip allen head when loosening & ONLY FINGER tight when tightening.
- Open O2 container, remove plastic sticker on bottom of sensor, and turn upside down back inside the container. Allow to breath for 15-20 minutes. Remove the cover, O2 located in the back left. Unplug the three pin connector on the top of the sensor, loosen turning counter clockwise and remove. Install new sensor, marking install date, turning clockwise into the sensor block. Re-attach the three pin connector to the sensor. Attach cover back on the main housing.

These three items must be regularly changed out per the above intervals. Other items not as critical or more complicated are described below and should be maintained at the intervals indicated.

- 4) NOX Sensor; part #: EMS-5065; 6 month min. re-calibration for accuracy and 2-3 Year Interval change out, or ERROR code E1000 model 5001.
- NOX Sensors should re-calibrated a min of 6 month intervals. New NOX sensors require re-calibration as well as NOX accuracy checks.
- NOX Sensor E1000 model 5001 will appear if the sensor is bad.
- TOOLS: 2 mm key style allen wrench
- Remove the 12 #6 button head screws with 2mm allen. Be careful not to strip allen head when loosening & ONLY FINGER tight when tightening.
- Remove the cover, NOX located in the back left. Unplug the four pin connector on the top of the sensor, loosen turning counter clockwise and remove. Install new sensor, marking install date, turning clockwise into the sensor block. Reattach the four pin connector to the sensor. Attach cover back on the main housing.

#### 5) Water Trap Assembly Filter; part #: EMS-5371; 3-6 month min. Interval

Water Trap Assembly filter is a disposable filter, with the sample flow from inside/ out so you will not see contamination. Carbon build up could cause a LOW Flow error. Unscrew the filter bowl turning clockwise to loosen. Unscrew the filter retainer turning clokwise, remove the coalescing filter. Install new filter, tighten filter retainer counter-clockwise, Screw on the filter bowl turning counter clockwise to tighten. NOTE: The air flow through this filter is from the inside/out, so to inspect the filter contamination, the coalescing filter must be removed to inspect.

#### 6) General Every Day Operation Tips for Instrument Life.

- Turn the 4 or 5 gas on in the morning in display mode and allow the instrument to warm up and go into auto shut down mode. This will keep the bench ready for use when needed, with out having to wait for the instrument to warm up. This will not damage the unit and help save time.
- Moisture is your BIGGEST enemy for this instrument life! If any moisture build up is visible in the analyzer clear hoses, allow the instrument to dry out by running ambient air through the analyzer continuously for a minimum of 30 minutes or until NO moisture is present in the hoses.
- Sample Hose and S.S. probe should be blown out with compressed air at the end of the day. Moisture build up will leave carbon build up inside the hose and deteriorate the hose causing leaks. Clean sample hose once or twice a year by soaking in hot soapy water, blow out with compressed air.
- Leak Check should be performed after every filter change out to insure no O2 leaks causing invalid gas readings. Plug the inlet quick connector on the analyzer for an internal leak check. The model 5002 will show LOW FLOW on the screen and the pumps will shut off, and if the pumps stay off 30 seconds there are no leaks.
  - Leak Check your sample hose and probe every filter change out only after you have verified no internal instrument leaks. Connect the sample hose to the analyzer and plug the end of the probe with the red/black plastic cap supplied by EMS. The same low flow codes will come up as described above and the low flow should hold for 30 seconds.

- Leak check failures would be if the 5002 model pumps turn on during the 30 seconds. The most common leak location is at the external filter head, this can be check with a butane lighter to see if your HC reading increases. Make sure the filter is screwed on straight and the O-Ring is moistened. If the leak is at the internal filter, twist the filter in the hose and make sure zip tie is tight or replace. If a leak is found in the sample hose or probe, ORDER NEW parts. Sample Hose part #: EMS-5096-25, Handle part #: EMS-5097, S.S. Probe part #: EMS-5098.
- **Two Cycle gasoline testing:** Two cycle fuel is much more of a maintenance issue than standard gasoline or diesel testing. In order to determine a good maintenance schedule, check the filters once a week with a visual inspection. If a yellowish build up in the external filter is present, this is oil contamination, and will possibly give you inaccurate readings due to HC residual build up. This would be seen after ZEROING the unit, and HC readings being displayed without taking an exhaust sample. This would indicate filter change out is required. For the pre-filter water trap sintered bronze filter, any yellowish or oil build up would require cleaning with hot soapy water. Make notes of how many tests have been preformed so you can get a bench mark for your filter change out or cleaning. If you are not changing out and cleaning the filters, this could result in a bench failure due to oil contamination build up inside the IR bench. Also be careful of how long you sample this exhaust. A longer test can result in contamination, so only allow the unit to sample as long as needed, and afterwards, always allow the unit to purge out any contamination by running fresh air for as long as possible, or a minimum of 15 minutes or auto shut down in stand by mode. This is the best thing to do after sampling any engine and will prolong the analyzer component life.

**OIL/WATERSEPARATOR**: The new High Performance Oil Water Separator, EMS-5151, has been added to remove more oil/water before the automatic drain water trap assembly. The separator should be drained daily by unscrewing the oil/water reservoir daily. The Large Body Separator, EMS-5150, has a ball valve drain The separator will work better in colder weather, to enhance the capability of the separator in hot humid weather, EMS recommends to make a home made oil/water condensor by attaching a ICE bath. This can be done with a plastic cup filled with ice around the reservoir, or you can use a can cooler with a plastic sandwich bag around it to hold the melted water. This simple trick will be very effective in pulling more moisture out of the sample , very similar to the official state run facilities with DYNO testing. Give it a try and you will see a huge difference! See pg, 19 & 20 for detail pictures.



**Oil/Water Separator with Plastic Cup Ice Bath** 



#### Oil/Water Separator with Can Cooler Ice Bath

**Diesel Testing when Urea is used to reduce NOX (SCR)** : The EMS analyzer is fully capable of diesel testing. Your HC reading will only be accurate for Hexane gas, so a Smoke/Opacity meter would be required to check PM. All other gases will be accurate including NOX. For diesel systems using the SCR system that sprays UREA in the exhaust to eliminate NOX, this chemical reaction produces Ammonia. The presence of ammonia in vehicle exhaust presents some problems for gas analyzers and sampling systems. Ammonium salts readily precipitate in the exhaust sample stream, which can contaminate FID and optical gas bench components. To protect the AMBII bench, a special version of the inline filter element, EMS-5093-CS, has been developed that will absorb the ammonia before entering the analyzers. This would need to be added in the field, or ordered as an extra accessory for any new units.



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# Spare Parts and Accessories

#### Part No: Description

EMS-5060 **Oxygen Sensor EMS-5065 NOx Sensor EMS-5093 Internal Filter EMS-5096** Exhaust Hose **EMS-5097 Exhaust Handle EMS-5098 Exhaust Probe EMS-5210 Power Cord EMS-5500** Gas Calibration Kit **EMS-5020 12V Sample/Water Pump EMS-5031** 12V HD Solenoid Valve **Optical Bench EMS-5040 EMS-5041 Repaired Optical Bench Flow Switch EMS-5050 EMS-5070 External Filter Head** 7" Display Screen **EMS-5302 EMS-5306 12 VDC Power Supply** AC/DC Power Supply 5.5 AMP **EMS-5256 USB to Serial Adapter 13" EMS-5257 EMS-5258 DB9 Serial Cable 6 ft Long EMS-5259** DB9 Serial Cable 15 ft. Long EMS-5098-1/4-20 Exhaust Probe 1/4-20 Threaded End **EVAP/Small Engine/Motor Cycle Probe EMS-5099 EMS-5150** Large Body Oil/Water Separator **Small Body Oil/Water Separator EMS-5151** EMS-5093-CS In-line Absorber Filter for Diesel/Urea **EMS-5370 External Filter Assy.** EMS-5371 **External/Water Trap Filter** EMS-5372 Water Trap Assy.

### **Diagnostic Accessories**



The EMS water separator assembly (Fig. 1) is essencial for road testing, Dyno use, Diesel testing, motor cycle testing, and two cycle fuel testing. This accessory will prolong the analyzer life by pulling more moisture out of the sample gas.

The Y-Valve assembly (Fig. 2) was designed for pre-catalytic converter testing. With the real benefit being able to hook up both pre & post cat sample hose & probes. And swich between both readings at the analyzer, which saves you time. Also check back pressure on the pre-cat side at the analyzer with our inline pressure gauge (Fig.3)

EMS also offers a pop nut insert tool kit (Fig.4) for the pre-cat probe w/ a 1/4"-20 threaded end. The kit includes the pop nut insert tool, 1/4-20 mandrel, box of 40 nuts, 50 pc's 1/4-20x3/8" stainless steel SHCS, 25/64" drill bit The EMS EVAP probe,( small engine) (Fig. 5) is 3/16" O.D. and very flexable to help find radiator or exhaust leaks in tight spaces.



Figure 1











Figure 4





# **Diagnostics**

Exhaust gas analyzers can be used to diagnose driveability concerns, ignition system problems, fuel management issues, engine mechanical problems, excessive emissions problems and many other vehicle systems. Vehicle inspection and preparation are the keys to getting the most out of your gas analyzer.

1. A visual inspection should include; vacuum hoses, air filter, exhaust system, air management system, emission related components, etc. If the malfunction indicator light (MIL) is illuminated, check the diagnostic trouble codes (DTC's) prior to testing.

2. Vehicle preparation:

a. The engine should be at operating temperature prior to testing.

b. Start the engine and run until the cooling fan cycles on and off. Another option is using a scan tool to check the engine coolant temperature (ECT). The temperature should exceed 190 degree F.

c. After the engine is warm, increase the engine speed to 2500 RPM for approximately 60 seconds.

d. Return the engine speed to idle.

e. Insert the sample probe and begin your diagnostics.

Understanding the relationship of exhaust gases will enhance your ability to diagnose driveability issues. The Exhaust Gas Relationship Chart will provide a few suggestions:

EFFECTS OF ENGINE CONDITIONS ON EMISSIONS									
	HC	CO	CO2	02	NOX				
Ignition misfire	Very high	Lower	Lower	Much higher	Much lower				
Compression loss	Very high	Lower	Lower	Higher	Much lower				
Rich fuel mixture	Higher	Very high	Lower	Lower	Much lower				
Lean fuel mixture	Higher	Much lower	Lower	Higher	Much lower				
Very lean fuel mixture	Very high	Very low	Lower	Very high	Higher				
Slightly retarded timing	Lower	No change	No change	No change	Much lower				
Very retarded timing	Higher	No change	Much lower	No change	Higher				
Advanced timing	Higher	No change	No change	No change	Much higher				
EGR operating	No change	No change	Lower	No change	Much lower				
EGR leaking	Higher	No change	No change	No change	No change				
AIR system defective	Higher	Higher	Lower	Much lower	No change				
Catalytic converter dead	Higher	Higher	Lower	Higher	Higher				
Exhaust leak	Lower	Lower	Lower	Higher	No change				
Worn rings/valve guides	Higher	Higher	Lower	Lower	No change				
Flat camshaft lobe	No change	No change	Lower	No change	No change				

Exhaust gas analyzers can be used to diagnose other vehicle systems. Here are a few suggestions:

- 1. Evaporative emission system operation.
- 2. Evaporative emission system leaks.
- 3. Fuel oders in and around the vehicle.
- 4. No-Start conditions.
- 5. Engine combustion gases in the cooling system.
- 6. Air injection emission systems.
- 7. Exhaust system leaks.
- 8. More...

# Warranty

• Emission Systems products are guaranteed to be free of defects in material and workmanship to the original purchaser, for a period of one year from the date of purchase. Probes and electrical leads are warranted for ninety days. The optical bench is warranted for 1 Year.

• This warranty does not apply to products which have been:

1) Altered

2) Improperly installed, maintained or repaired.

3) Damaged by accident, negligence or misuse.

# • THIS WARRANTY EXCLUDES ALL INCIDENTAL OR CONSEQUENTIAL DAMAGES

• If you suspect there is a problem with your unit, the operating manual should be reviewed first. Your particular problem may be covered in the operating instructions. If the issue cannot be resolved, contact EMS or your authorized distributor for additional information. If the unit requires repair, contact EMS to obtain a Return Authorization Number. The unit should be properly packaged and should include all accessories. The customer is responsible for shipping the unit back to EMS for warranty repair. The unit should be returned in the shortest possible timeframe at customers cost, EMS will return the unit with the same shipping

• In the USA and Canada call: 847-669-8044 for assistance.

• Outside USA call your authorized distributor for assistance.

Warranty Information:

- Date of Purchase: \_\_\_\_\_\_
- Serial Number: \_\_\_\_\_\_