

# EMS

EMISSIONS SYSTEMS, INC.

## Portable Exhaust Gas Analyzer Operators Manual Rev 2019

Model # 5003 (4 & 5 Gas) Live Reading only and  
Model # 8000 (Wired RS232)



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# Technical Data

Power: 10 -16 VDC  
Ranges: 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\*
- HD Touch Screen display: 7 “
- Accuracy ( Bar 97 EPA ASM ) HC: 4 ppm HC  
CO: 0.02% 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 Max.
- Sample probe: Stainless steel 1200 Degrees F ( replaceable flex tip )  
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.

**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 a couple hours! 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 carbon build up due to moisture!

Figure 1 highlights the features and buttons available on the Model 5003 front display area. The HC will display up to five digits and is in ppm, CO is in percentage, CO2 is in percentage, NOX is in ppm, O2 is in percentage, LAMBDA and AFR. The buttons will be described later in this manual.

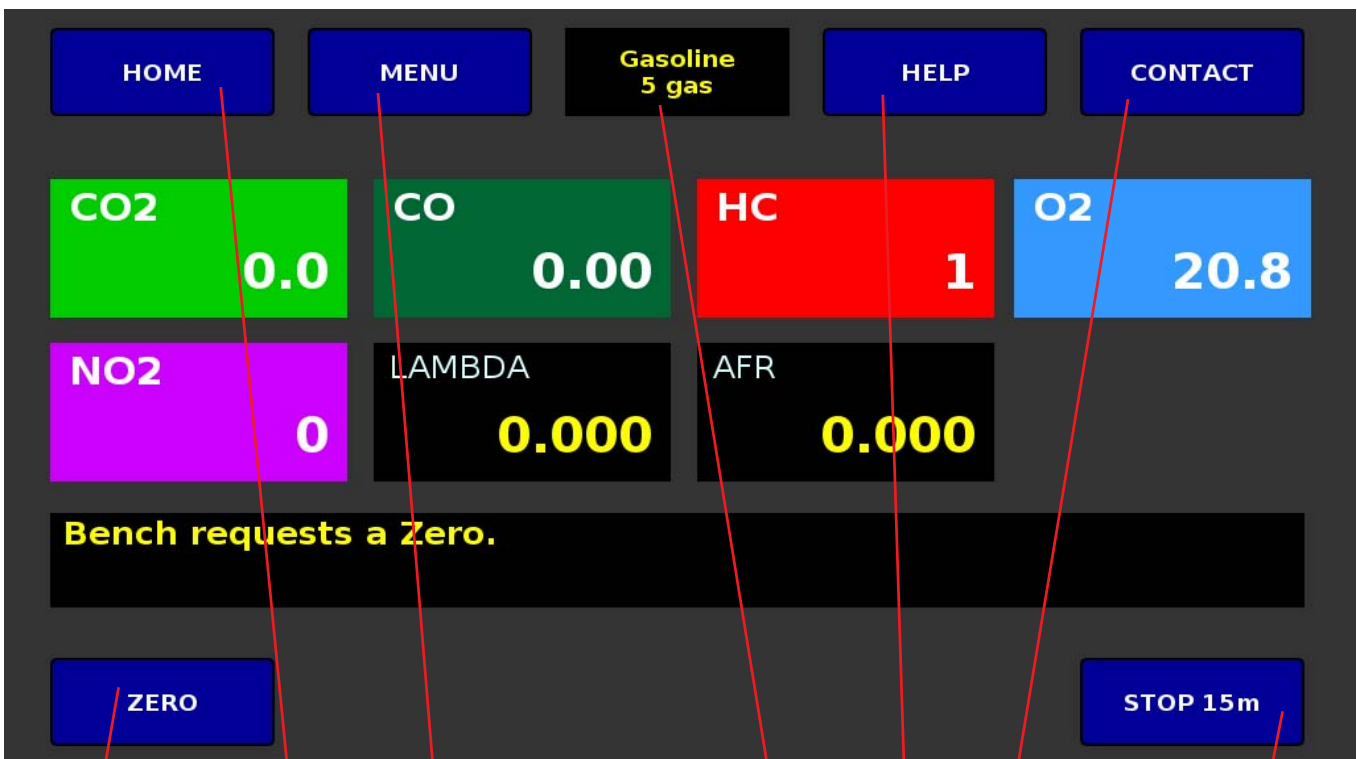


Figure 1

**ZEROING  
BUTTON**

**MENU  
BUTTON**

**FUEL & 4  
OR 5 GAS  
SETTING  
WINDOW**

**CONTACT  
BUTTON**

**HOME  
BUTTON**

**HELP  
BUTTON**

**15 min.  
SHUT  
DOWN  
BUTTON**

# Button Operation Model 5003

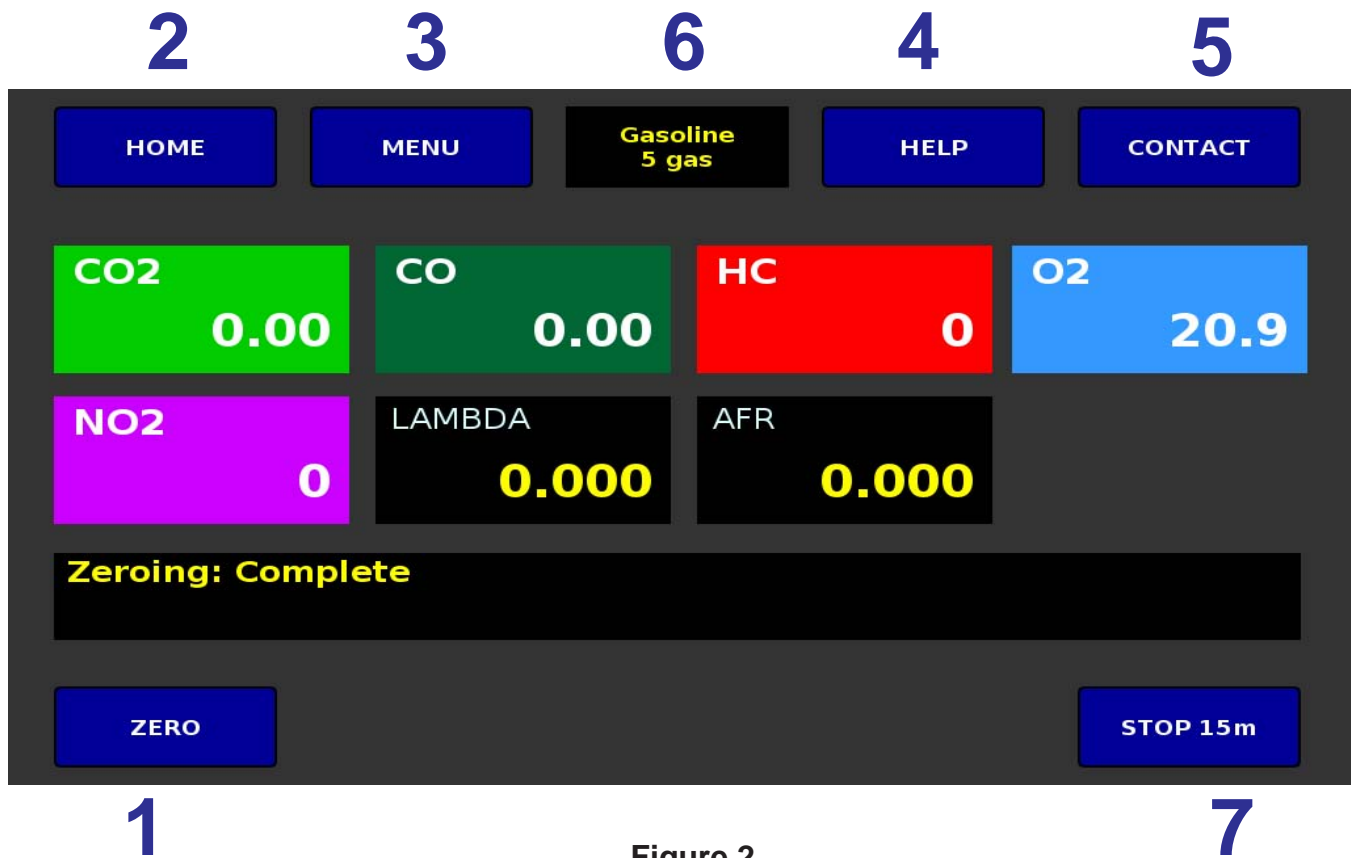


Figure 2

Figure 2 shows the control buttons on the touch screen of the gas analyzer:

1. The **“Zero”** button has two functions.
  - a. Zeroing the gas analyzer as needed during use.
  - b. Restarting the pump following automatic shutdown.
2. The **“Home”** button has one function.
  - a. Brings you back to Gas Sample screen
3. The **“Menu”** button has several functions.
  - a. Access calibration screen
  - b. Change Fuel Type
  - c. Change display to 4 or 5 Gas
  - d. Leak Check for sample system
  - e. Maintenance Log
  - f. Access Status for ERROR message screen
  - e. Access Set Up to Check bench SN and PEF Value or enter activation code, choose WiFi mode; Host or Client mode and Ethernet cable configuration.
4. The **“Help”** button is used to access the operations manual for touch screen operation, maintenance info.
5. The **“Contact”** button is for all the EMS shipping info, phone and website.
6. The **“Setting Window”** is for viewing what fuel type is picked (default is gasoline) and for 4 or 5 gas setting for reading NOX.
7. The **“15 Min Shutdown”** is for stand by mode or end of the day shutdown, once the button is depressed the pumps will run for 15 min. and shutdown pumps.



# Rear Panel Description

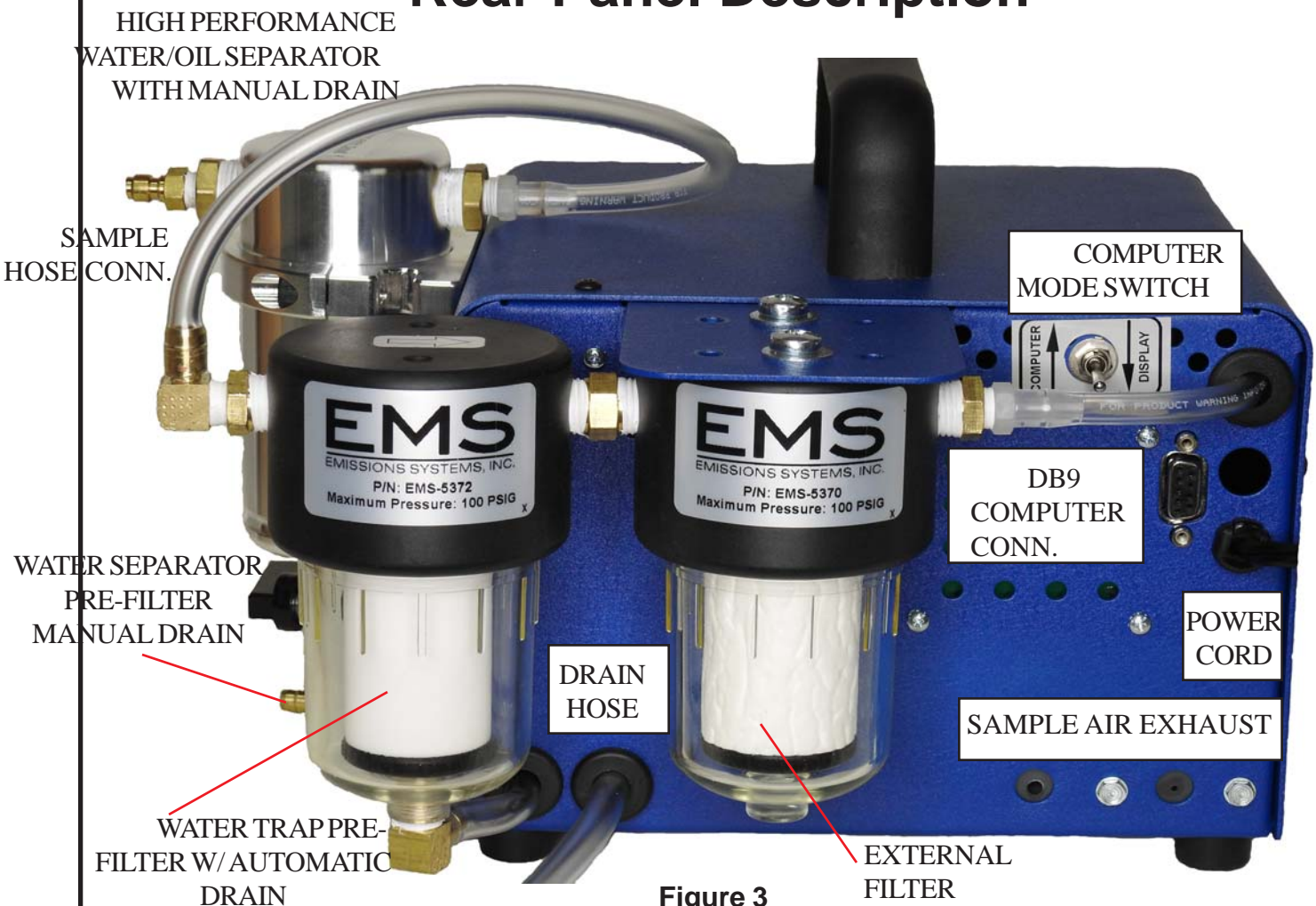


Figure 3

Figure 3 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.

**Sample Hose Connection:** The sample hose connection uses a quick disconnect coupler. This is helpful for storage of the analyzer and maintenance of the sample hose. The inlet is connected to a Oil/Water separator for pre-moisture extraction.

**Display Control Switch:** The display switch has two basic positions, Computer and Display. The switch should normally be in the DOWN position "Display". If you are using PC software for display or recording, the switch should be in the UP position. **Note: The switch direction is based upon you looking at the display. The switch should be changed only with power turned off.**

**DB9 Computer Connection:** This is used to connect the analyzer to your PC/laptop or wireless antenna.

**Power Cord:** Connect to the appropriate voltage supply source.

**Sample Air Exhaust:** The analyzer discharges the sample air out these ports. **Do not plug..**

**Drain Hose:** This hose will drain moisture collected during the sample process.

**External Filter, Water Trap, Water/Oil Separator:** This is the primary filtration system. Filter maintenance will be discussed in the Maintenance section of this manual.

**Water Separator Drain:** Drain daily opening a ball valve.

# Gas Analyzer Preparation

Getting started is simple. Figure 4 shows the items you should have received in the shipping container. **Note: This description applies to the Model 5003 analyzer with a live reading only display.** The first step is assembling the sample hose. Once the sample hose, handle and S.S. probe are assembled, connect the hose to the sample hose QD fitting on the inlet connection of the water/oil separator.



Figure 4

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 5 (Supplied by EMS)
2. Cigarette lighter to battery connection with adapter - Figure 6 (Optional)
3. AC to DC Power Supply - Figure 7 ( 5 AMP min. and 10 AMP) (Optional)



Figure 5



Figure 6



Figure 7

**NOTE: Power supply voltage to the analyzer needs to be a consistent 12 VDC. If any start up issues occur check power supply or battery.**

# Gas Analyzer Operation

Shortly after applying power, the analyzer will display the EMS logo & world start up screen. It will disappear once and reappear (Figure 8) for approx. 15 sec. then switch to the Home sampling screen (Figure 9). This starts the analyzer warm-up mode and will continue for approximately 5 to 10 minutes, depending on ambient temperature. Once the warm-up is complete, the analyzer will go into the “ZEROING” mode to set all the gases to zero. Then the gas sample mode will display all the gas values (Figure 10). 4 Gas units will show CO<sub>2</sub>, CO, HC, O<sub>2</sub> (figure 11) **Note: Below the gas data is a status line where operations and/or errors will be displayed.**



Figure 8

Figure 9



Figure 10

Figure 11

Once the analyzer has completed the warm-up, 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. Use the analyzer in a well vented area. EMS can supply a venting hose assembly.**

**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.**

**Caution: Monitor the clear hose between the filter assembly and the housing. 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 sample 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 O<sub>2</sub> by pressing the “ZERO” button (Figure 12). Once the button is depressed, you will see the button turn red showing the button was depressed (Figure 13). When this operation is being done “ZEROING” will be displayed in the status line (Figure 14) and will flush the bench for 30 sec. with ambient air from inside the analyzer. If the pumps are shut down, push the “ZERO” button and the pumps will automatically start. **Note: The sample probe should be removed from the tailpipe, when the unit is being zeroed.**

**Request Zero:** The analyzer will automatically request a zero as needed. If the analyzer requests a zero during sampling, you can finish your test first before Zeroing. The bench controls the Zero requests, normally after several hours of running the bench will not request a Zero, but long sampling or drift may cause this request. If any readings are jumpy due to contamination, just keep the pumps running and Zero often till the readings stabilize.



Figure 12

Figure 13



Figure 14

Figure 15

**Low Flow Warning:** If gas flow into the bench becomes restricted due to clogged filters or restricted sample hose, the **status line will indicate “LOW FLOW”** (Figure 15) and the pumps would shut off. To clear the LOW Flow warning, go to the Leak check screen to perform a leak test. Disconnect and check the sample hose for restrictions or kinks. If no problems are found, check the filters. Begin with the External and water trap filter then check the Internal filter. Keep in mind, the water trap assembly 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. The best check is to look at the bottom of the water trap filter. If the **LOW FLOW** continues to be displayed, the solenoid valve will need to be checked or possibly replaced due to carbon buildup. Pumps will start once the restriction is cleared.

# MENU SCREEN

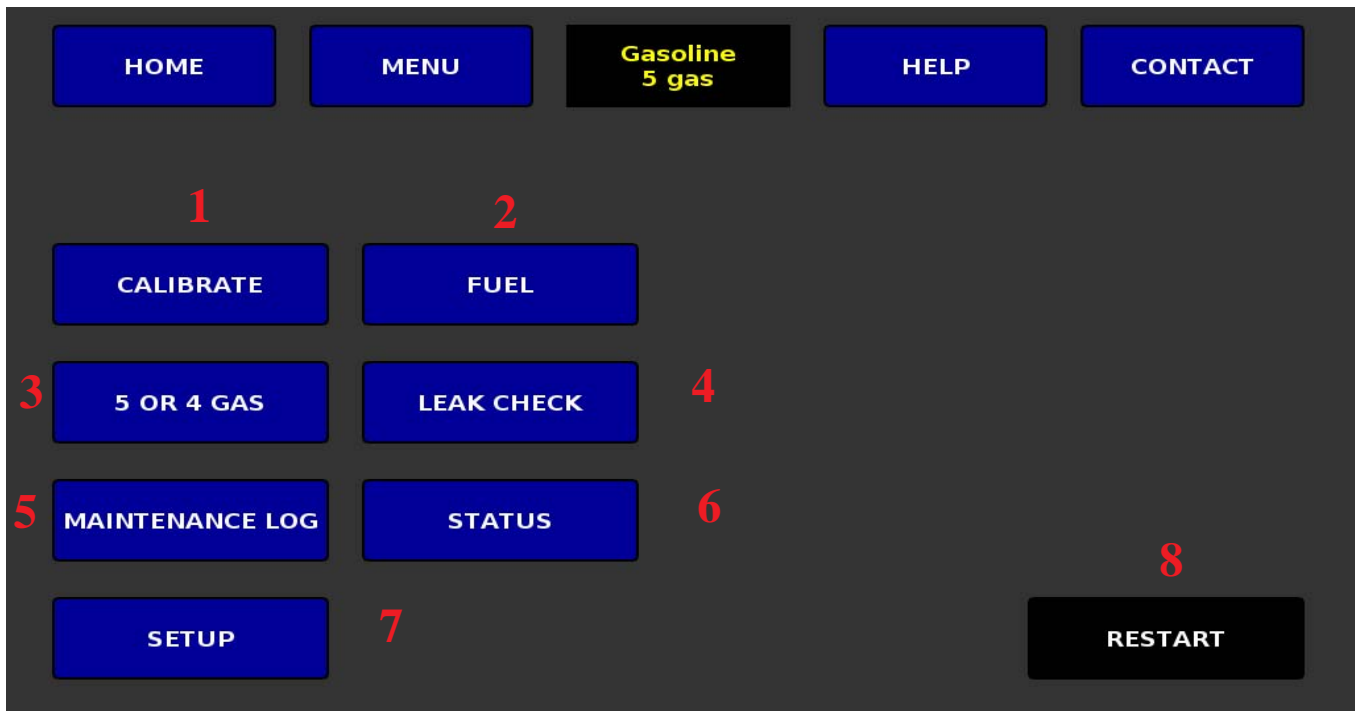


Figure 16

Figure 16 shows the control buttons on the MENU touch screen of the gas analyzer:

1. The “**CALIBRATION**” button has one function.
  - a. Calibration of HC,CO,CO<sub>2</sub>,Nox.
2. The “**FUEL**” button has one function.
  - a. Change the fuel type being tested to correct the AFR/LAMBDA formula.
3. The “**4 or 5 GAS**” button has one function.
  - a. Changes the HOME screen to display 4 gases or 5 gases.
4. The “**LEAK CHECK**” button is used to check for leaks inside the analyzer or the complete analyzer and sample hose probe assembly..
5. The “**MAINTENANCE LOG**” button allows you to enter a date of filter and sensor change out.
6. The “**STATUS**” is for viewing any error messages from the bench and sensors.
7. The “**SETUP**” button has several functions
  - a. Check the EMS display software version.
  - b. Check the bench SN.
  - c. Check bench PEF values; LOW and HIGH.
  - d. Enter the display software Activation code.
  - e. Ethernet cable configuration Data Acquisition interface.
  - f. Choose WiFi mode; Host mode: EMS live reading display interface.
  - g. Choose WiFi mode; Client mode: Data Acquisition interface
  - e. Access Status for ERROR message screen
8. The “**RESTART**” is for restarting the EMS processor for debugging in case of connection problems so you don’t power down the analyzer. **Note:** If you restart the processor and go back to the Home screen, a **Zero** is required to establish bench communication. **Note: Restart is required after WiFi Host or Client mode is selcted.**

# Calibration

The gas analyzer should be checked periodically for accuracy. For normal shops using the analyzer this would be approx. 3-6 months, for higher usage approx. every 1 month or more. 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 (Figure 17). The calibration Kit (EMS-5500) can be purchased from EMS or your local distributor. The recommended calibration gas is Bar 97 Low and can be purchased from EMS, Part No.EMS-5502; BAR 97 LOW.

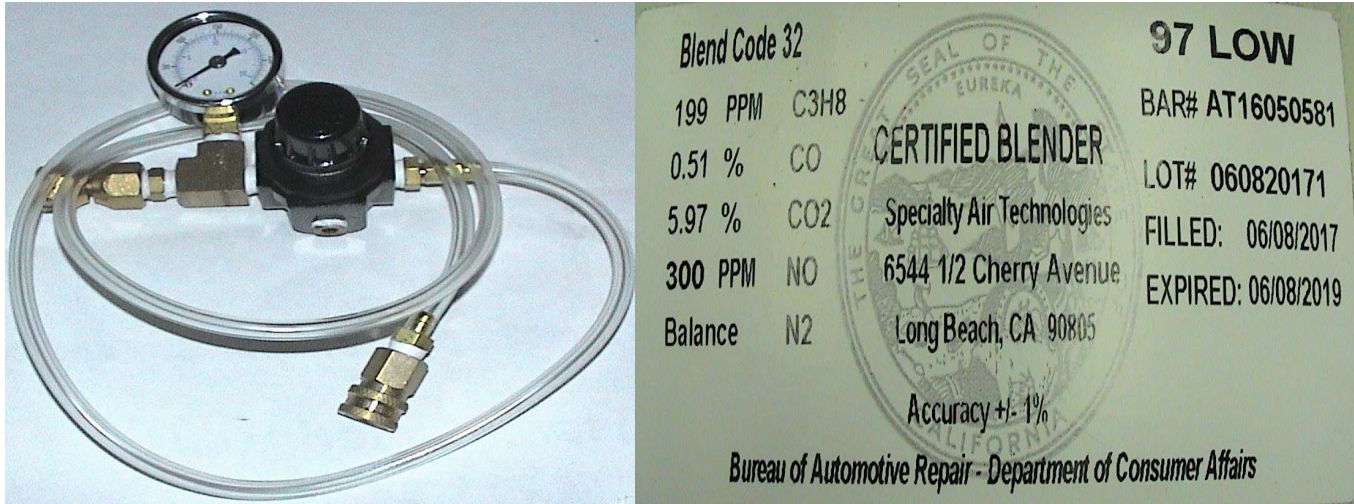


Figure 17

## Calibration Procedure:

- To begin the calibration procedure depress the “Menu” button on the Home sampling screen. The main menu screen will show you the “**Calibration**” button (Figure 16) Press the “CAL” button and the display will go to the calibration screen and show the stored calibration gas values highlighted in white box (Figure 18). Compare these numbers to the calibration gas bottle. If the numbers do not match, change the values by pressing each gas value box, a key pad will open ( Figure 19) press Back to clear the value, and enter the new values for each gas as needed and press the Ent, enter button. Once the values are changed press the “Accept” button. **NOTE:** In 4 Gas mode the Nox window will not appear or be calibrated in the calibration routine.



Figure 18

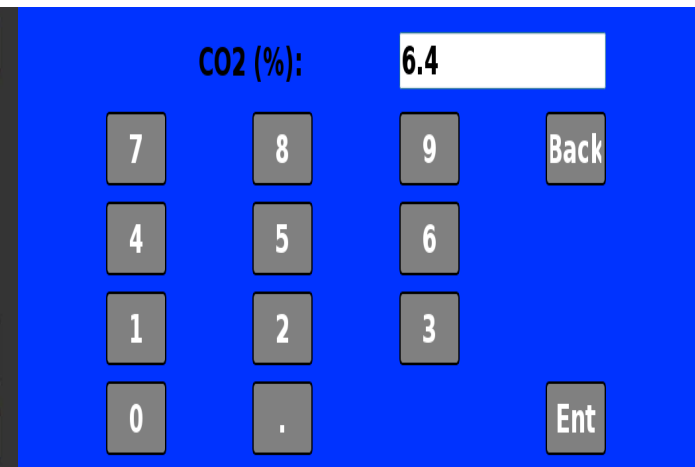


Figure 19

# Calibration

**Figure 20**

GAS CALIBRATION Step (1 of 2)

C3H8 (ppm):	208
CO (%) (ppm):	0.55
CO2 (%):	6.4
NO (ppm):	303

Zeroing: 20 seconds

ZERO Save

**Figure 21**

GAS CALIBRATION Step (2 of 2)

C3H8 (ppm):	208	283	36.06 %	TIMER (sec)
CO (%) (ppm):	0.55	0.74	34.55 %	11
CO2 (%):	6.4	5.80	9.38 %	O2 %
NO (ppm):	303	224	26.07 %	2.2

Attach cal gas, wait for values to stabilize, press save button

ZERO Save

2. The status line will display “Zeroing” (Figure 20) once the calibration gas values have been sent to the bench, the analyzer will Zero for 30 seconds. then the calibration screen 2 will appear (Figure 21). Once screen 2 appears, calibration gas can be connected and turned on as indicated on the status line. **(Note: Do not adjust the regulator, this was preset to the appropriate flow rate. DO NOT press the save button with out calibration gas attached and flowing to the analyzer.)**

3. Cal 2 screen shows 3 columns. The first column shows the stored calibration values typed in from the cal bottle screen 1. The middle column will display the cal gas live reading values from the cal bottle, the last column is a % variance to the calibration values and the live readings. With the cal gas connected, once the gas values stabilize (Figure 22), Note: The O2 reading must be 1% or less to activate the save button. press the “Save” button ( Figure 23). The status bar will show saving cal data, and then calibration complete, and the values should be reading accurately. A percentage difference value is shown in the 3rd column to see how far off calibration was before and then after calibration (Figure 24). The calibration process is now complete. Turn the calibration gas off to save gas. The calibration process should take approx 30-40 sec.

**Figure 22**

GAS CALIBRATION Step (2 of 2)

C3H8 (ppm):	208	211	1.44 %	TIMER (sec)
CO (%) (ppm):	0.55	0.60	9.09 %	18
CO2 (%):	6.4	6.20	3.12 %	O2 %
NO (ppm):	303	286	5.61 %	1.0

Attach cal gas, wait for values to stabilize, press save button

ZERO Save

**Figure 23**

GAS CALIBRATION Step (2 of 2)

C3H8 (ppm):	208	211	1.44 %	TIMER (sec)
CO (%) (ppm):	0.55	0.60	9.09 %	20
CO2 (%):	6.4	6.20	3.12 %	O2 %
NO (ppm):	303	286	5.61 %	1.0

Attach cal gas, wait for values to stabilize, press save button

ZERO Save

Figure 22

Figure 23



# Calibration



Figure 24

Figure 25

**NOTE:** The hydrocarbon gas in the calibration cylinder is propane (LPG), 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 (Figure 25) 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. The PEF value (Propane equivalence factor) can be used to calculate the Hexane gas value. You have access to the bench PEF value in the SETUP Menu screen. You can also go into the fuel selection screen and pick LPG for an accurate calibration gas value that the display calculates automatically. **NOTE: EMS recommends allowing the analyzer to warm up for a min. of 1 hour before calibrating. You may also need to calibrate more than once to get the Nox sensor to calibrate more accurate, especially for BAR 97 HIGH gas. If checking accuracy you will also see the Nox get more accurate as you allow the analyzer to run, warming up all the sensors to a consistent temperature approx. 2-3 hours.**

**After calibration you will see a Bad Nox sensor message, this is a False error we can't seem to eliminate! Zero the analyzer on the Home screen to clear the error message.**

# FUEL SELECTION

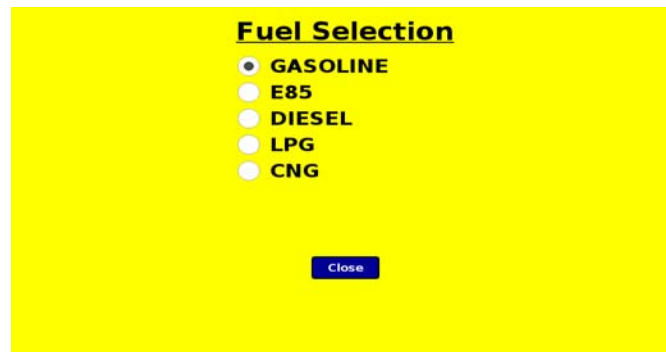


Figure 26

The default fuel is Gasoline, you can pick from the default and E85, Diesel, LPG, & CNG fuel (Figure 26). The purpose of the fuel change is to calculate the LAMBDA/AFR value more accurately for the different fuel types. This is done by changing the atomic ratio's of the different fuels in the LAMBDA formula. The formula used is the Brechtscheinder Formula (Figure 27).

## 1. Lambda and AFR Calculation

The Emissions Analyzer software uses the Brechtschneider equation as the basis for determining the value for Lambda or Air Fuel Ratio (AFR). This equation is the de-factor standard method used to calculate these values. The basics of the equation are shown here, but for more information please see the paper written by Dr. Johannes Brechtschneider, at Robert Bosch in 1979 and published in "Bosch technische Berichte", Vol 6 (1979) NO. 4, Pgs 177-186.

$$\lambda = \frac{[CO_2] + \left[\frac{CO}{2}\right] + [O_2] + \left[\frac{NO}{2}\right] + \left( \left( \frac{H_{cv}}{4} \times \frac{3.5}{3.5 + \frac{[CO]}{[CO_2]}} \right) - \frac{O_{cv}}{2} \right) \times ([CO_2] + [CO])}{\left( 1 + \frac{H_{cv}}{4} - \frac{O_{cv}}{2} \right) \times ([CO_2] + [CO]) + (C_{factor} \times [HC])}$$

[XX] = Gas concentration in % volume

H<sub>cv</sub> = Atomic ratio of hydrogen to carbon in the fuel

O<sub>cv</sub> = Atomic ratio of oxygen to carbon in the fuel

C<sub>factor</sub> = Number of carbon atoms in each of the HC molecules being measured

$$AFR = \lambda \cdot AFR_{STOICH}$$

AFR<sub>STOICH</sub> = The stoichiometric value for AFR

Figure 27

# 4-5 GAS SELECTION

The Gas Analyzer will be set up for 4 or 5 gas operation at the time of purchase. The 4 gas unit displays HC,CO,CO<sub>2</sub>, O<sub>2</sub>, AFR and LAMBDA and the 5 gas unit has HC,CO,CO<sub>2</sub>, O<sub>2</sub>, NOX, AFR and LAMBDA. The unit would not need to be changed by the customer. To choose 4-5 gas go to the menu screen and press 5 or 4 gas button , then choose the 5 or 4 gas button (Figure 28). Return to the Home screen and the display will indicate 4 or 5 gas in the setting window.

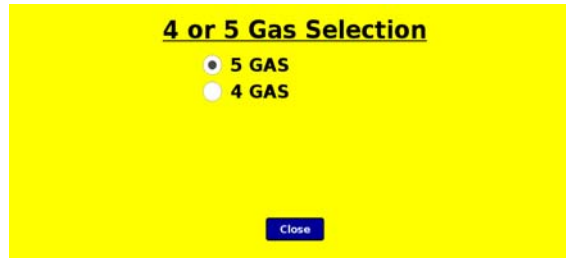


Figure 28

# LEAK CHECK SELECTION

The Gas Analyzer needs to be checked occasionally for LEAKS. O<sub>2</sub> leaks can cause gas readings to be off or not read at all. Leak Check should be performed after every filter change out to insure no O<sub>2</sub> leaks causing invalid gas readings. To perform a Leak Check press the menu button on the Home screen and press the leak check button on the Menu screen . This brings you to the leak check screen (Figure 29) Leak Check duration is 30 Sec.

Plug the inlet quick connector on the analyzer with a rubber cap for an internal leak check. The model 5003 will show LOW FLOW : Yes/No on the screen and the pumps will shut off, press the Test button to start the 30 sec. leak check. If the pumps stay off the duration of the test, there are no leaks and the test status will indicate pass/fail.-

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 the duration of the test. If a leak is detected, meaning the pumps turn back on losing vacuum, the most common leak is at the external filter bowl connection. This can be verified by using a butane lighter opening raw butane next to the filter head, your HC reading will spike if there is a leak. You should also check all threaded connections and hose connections including tie straps, twisting to ensure a seal.

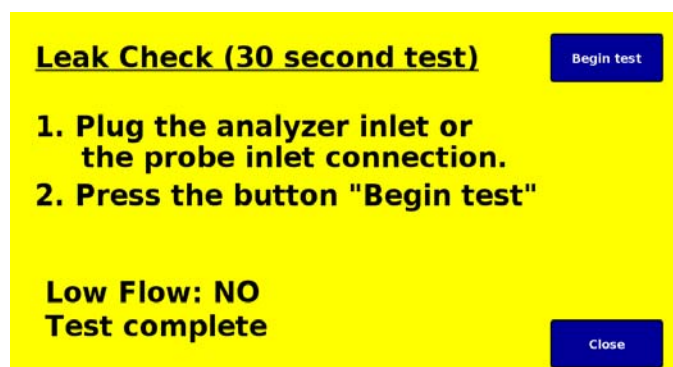


Figure 29

# MAINTENANCE LOG

The Gas Analyzer needs regular maintenance for filter replacement and sensor replacement ( See maintenance section for recommended change out frequency). EMS has given you a manual maintenance log to track filter and sensor replacement (Figure 30). The default date will be the time of manufacture. The main filters to replace are Water trap filter; EMS-5371, Particulate filter; EMS-5371, Internal filter; EMS-5093. Sensors are the O2 sensor; EMS-5060 and Nox sensor; EMS-5065.

To enter the date, press the box next to the description, and a key pad will open ( Figure 31). Press the clear (CLR) or the back space (BS) button to remove the existing date, then enter the new date and hit enter (ENT) button to close the key pad.

**Filter Change Out Dates:**

**Water Trap Filter:** 01-02-2018

**Particulate Filter:**

**Internal Filter:**

**O2 Filter:**

**NOX Sensor Filter:**

Close

Figure 30

**Passphrase:**

1	2	3	4	5	6	7	8	9	0	BS
!	@	#	\$	%	^	&	*	(	)	CLR
+	-	_	/	\	.	,	=	?	<	>
~	:	;	'	"	{	}	[	]		`
q	w	e	r	t	z	u	i	o	p	
a	s	d	f	g	h	j	k	l		Ent
y	x	c	v	b	n	m				ABC

Figure 31

# STATUS MESSAGES

If the optical bench detects any errors during operation, a message will be displayed on the Status Line of the Home screen. If any error messages comes up, press the menu button, and then press the status button (Menu Screen). At this point you can see any errors being sent from the optical bench (Figure 32). The errors that would possibly be displayed are:

- Bench in Warm Up: This is controller by the bench MP with a count down.
- Bench Requests a Zero: This is controller by the IR bench, press Zero button.
- LOW Flow: This would be clogged filter or restricted sample hose.
- HC Zero Warning: This could be a bad calibration or bad optical bench channel.
- CO Zero Warning: This could be a bad calibration or a bad optical bench channel.
- CO2 ZeroWarning: This could be a bad calibration or a bad optical bench channel.
- Bad NOX: This could be a bad calibration or a bad NOX sensor.
- Bad O2 : This would be a bad O2 sensor.

If an error message does appear and is a bad calibration or the optical bench detected as not normal, depress the “ZERO” button on the “Home” sampling screen to clear the error. If the error message doesn't go away, either the bench has an error or is bad or one of the sensors ( O2, NOX) need to be replaced. Note: After calibration, the bench sends a FALSE bad Nox error, Zero to clear.

**Status:**

NO Bench in warmup  
NO Bench requests a Zero  
NO Low Flow  
NO CO2 Zero warning  
NO CO Zero warning  
NO HC Zero warning  
NO Bad O2  
NO Bad NOx

Close

Figure 32



# SETUP MENU

The Gas Analyzer SETUP screen has information and WiFi/Ethernet cable configuration functions (Figure 33). The first 5 lines are information:

- 1) Version; Shows the version of display software on the display processor.
- 2) Serial #: IR Bench serial # and EMS ID.
- 3) PEF (LOW) Propane Equivalence Factor (PEF) for the analyzer. See calibration section for expanded explanation.
- 4) PEF (HIGH) Propane Equivalence Factor (PEF) for the analyzer.
- 5) Activation Code: SN specific activation code, contact EMS for your code # if required.

The next 3 lines are for configuring different connections that will be explained further in the next pages.

- 6) Ethernet: This configuration is for DATA Acquisition software interface.
- 7) WiFi Host Mode: EMS1 This is the live reading display WiFi interface.
- 8) WiFi Client Mode: This configuration is for DATA Acquisition software interface.

**NOTE:** After any WiFi configuration you must **Restart** the display from the **Main Menu** button 8 shown on page 10.

**EMS 5003 Setup Form** Close

**Version:** 2.19a (0:0.000)

**Serial #**

**PEF (low):**

**PEF (high):**

**Activation:**

**Ethernet:**

**Wifi Host Name:**

**Wifi Client Mode:**

Figure 33

# ETHERNET CONFIGURE SCREEN

The Ethernet configuration function allows you to connect to the net work and show the network IP address. You can do this two ways:

1) DHCP is a automatic connection; Press the DHCP function, then press connect (Figure 34). The connect button will turn red for up to 30 sec.and once connected will be blue again. Press Show IP to verify you are connected ( Figure 34).

2) Static is a manual connection for a data acquisition software that needs a specific IP address to communicate. Press the static IP box to open the keypad screen ( Figure 35). Enter your IP address press Ent to close. Press Netmask box and enter the Netmask value. Note: If configuring a STATIC IP for Ethernet and there is NO Gateway, then enter 0.0.0.0 for Gateway address. **NOTE:** After any WiFi configuration you must **Restart** the display from the **Main Menu** button 8 shown on page 10 to access the IP address.

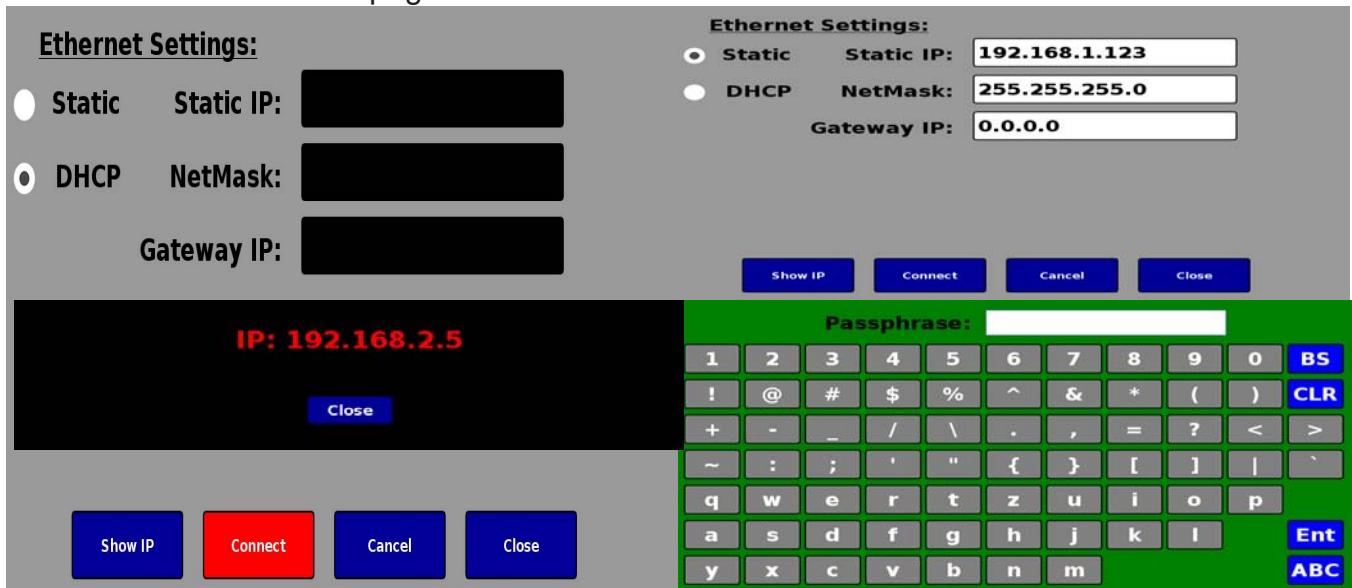


Figure 34

Figure 35

# WiFi HOST MODE SCREEN

The WiFi Host mode function allows you to connect to the analyzer for a live reading on a device:

1) When WiFi Host mode is selected ( Figure 36), EMS1 will appear in the window as a default name. You can change this name to what may be required for your shop. Press the WiFi host box and a key pad will appear, clear or back space the default name and enter the new name and press Ent. to close the key pad.

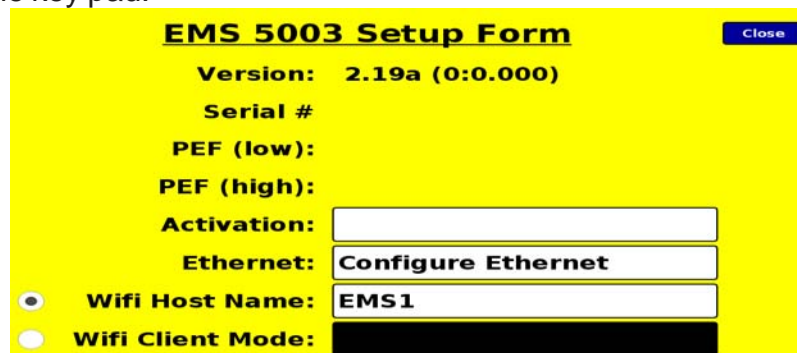


Figure 36

# WIFI HOST MODE SCREEN

The WIFI function allows you to connect to the Wireless LAN dongle via a web browser. Wireless LAN Connection: To connect to the EMS wireless dongle, open your device network connection screen ( Figure 37) click the EMS LAN connection; ie EMS1, it will require a password. The password is EMS three times: “**emsemsems**” (Figure 39). Once you have connected to the EMS dongle, open your web browser for connecting to the internet, type in the EMS code #: **http://10.1.1.1** (Figure 40-1) and your device will connect directly to the analyzer as master connection. The master device will have control of the ZERO function of the analyzer only. Any other device that connects must use;**http://10.1.1.1/view** this connection can view gas readings only, connect up to 25 devices at one time. (Figure 40-2).Note: The Gas Analyzer connection will disconnect you from the internet when used in Host mode. If you need the internet at the same time, contact EMS for an additional WiFi dongle so you can make a WiFi connection with an additional WiFi connection on your computer for the EMS WiFi connection (Figure 38). **NOTE:** After any WiFi configuration you must **Restart** the display from the **Main Menu** button 8 shown on page 10.



Figure 37



Figure 38

Type the network security key

Security key:

Hide characters

OK

Cancel

Figure 39

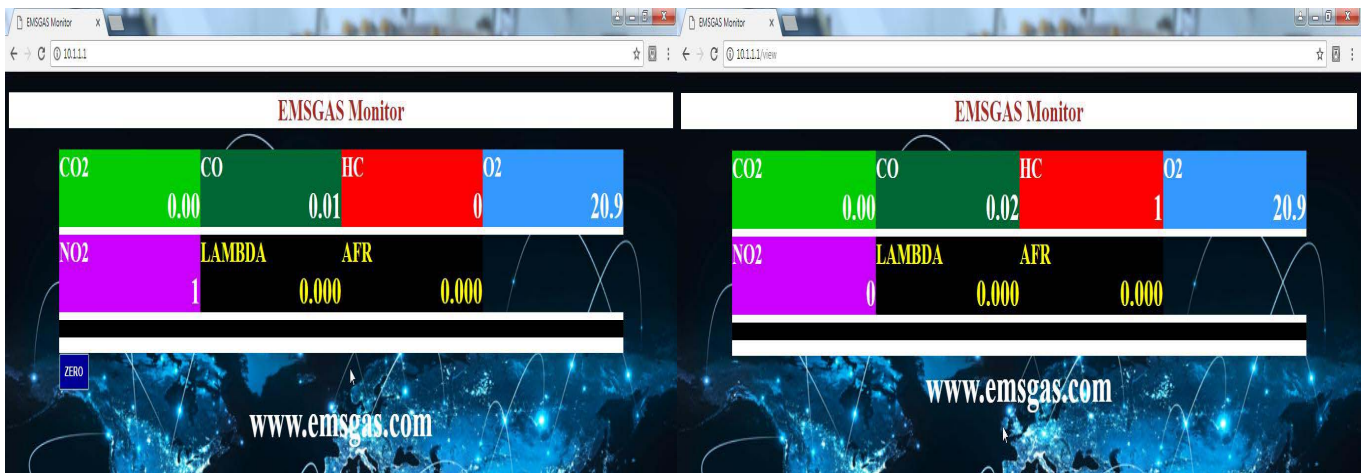


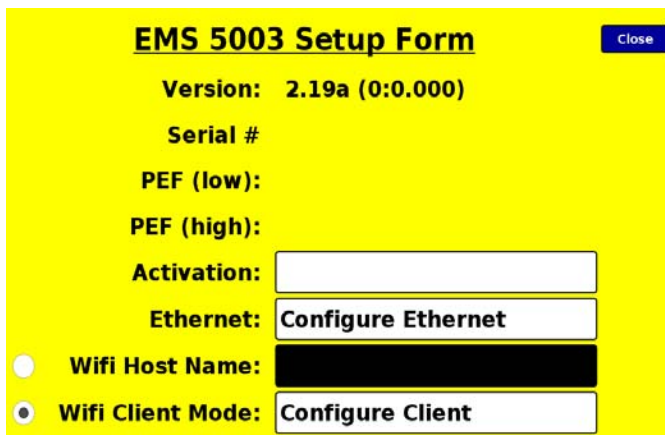
Figure 40-1

Figure 40 -2

# WiFi CLIENT MODE SCREEN

The WiFi CLIENT MODE function allows you to connect to the analyzer wirelessly for Data Acquisition with a Dyno or other software with the EMS5003 protocol to collect and control the analyzer.

- 1) When WiFi Client mode is selected, the main Client mode screen will appear to allow you to connect automatically "DHCP" or manually "Static" ( Figure 41).
- 2) Press the Scan button, and the WiFi will search for available networks ( Figure 42).
- 3) Once the Scanning is gone, press the WiFi Network box ( Figure 42). This will open a window showing available WiFi networks ( Figure 43), choose your network and press the close button.
- 4) Once you choose your network, press the Passphrase ( or Key) box ( Figure 44), this will open a keypad window ( Figure 45), press clear and enter your network password key, press "ENT" enter and you will be back at the client mode screen (Figure 44)



**EMS 5003 Setup Form** Close

Version: 2.19a (0:0.000)

Serial #

PEF (low):

PEF (high):

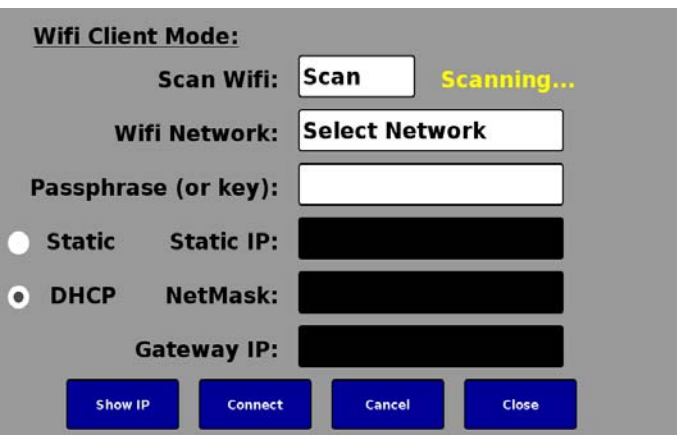
Activation:

Ethernet:

Wifi Host Name:

Wifi Client Mode:

Figure 41



**Wifi Client Mode:**

Scan Wifi:  Scanning...

Wifi Network:

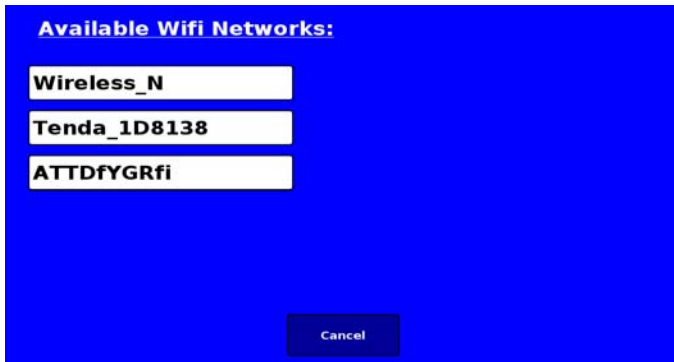
Passphrase (or key):

Static Static IP:

DHCP NetMask:

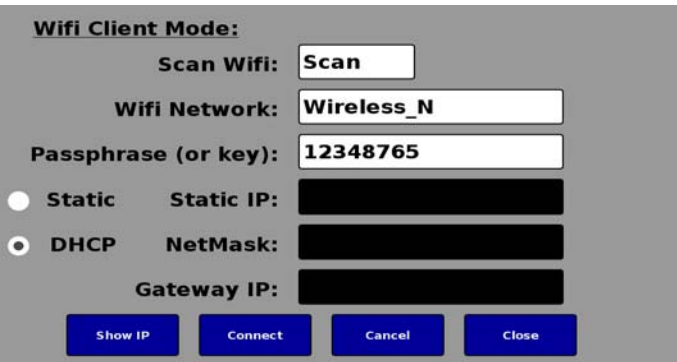
Gateway IP:

Figure 42



**Available Wifi Networks:**

Figure 43



**Wifi Client Mode:**

Scan Wifi:

Wifi Network:

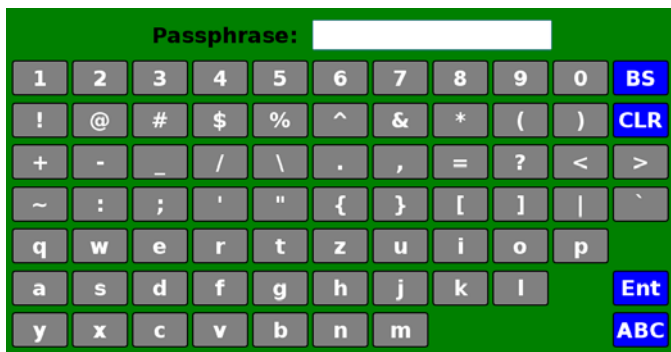
Passphrase (or key):

Static Static IP:

DHCP NetMask:

Gateway IP:

Figure 44



Passphrase:

1	2	3	4	5	6	7	8	9	0	BS
!	@	#	\$	%	^	&	*	(	)	CLR
+	-	_	/	\	.	,	=	?	<	>
~	:	;	'	"	{	}	[	]		`
q	w	e	r	t	z	u	i	o	p	
a	s	d	f	g	h	j	k	l		Ent
y	x	c	v	b	n	m				ABC

Figure 45



# WIFI CLIENT MODE SCREEN

5) Once you have entered your password key, press the “Connect” button, the button will turn red and once connected to the WiFi the button will turn blue again and the unit should be connected ( Figure 46).

6) To verify the analyzer is connected to the network, press the “Show IP” button and a window will open either giving the IP address or saying IP not set or NO IP: Try Connect ( Figure 47).

You can download a free IP address scan software at: [www.advanced-ip-scanner.com](http://www.advanced-ip-scanner.com) , this software will scan all the devices on your network and show the EMS IP address as being on the network.

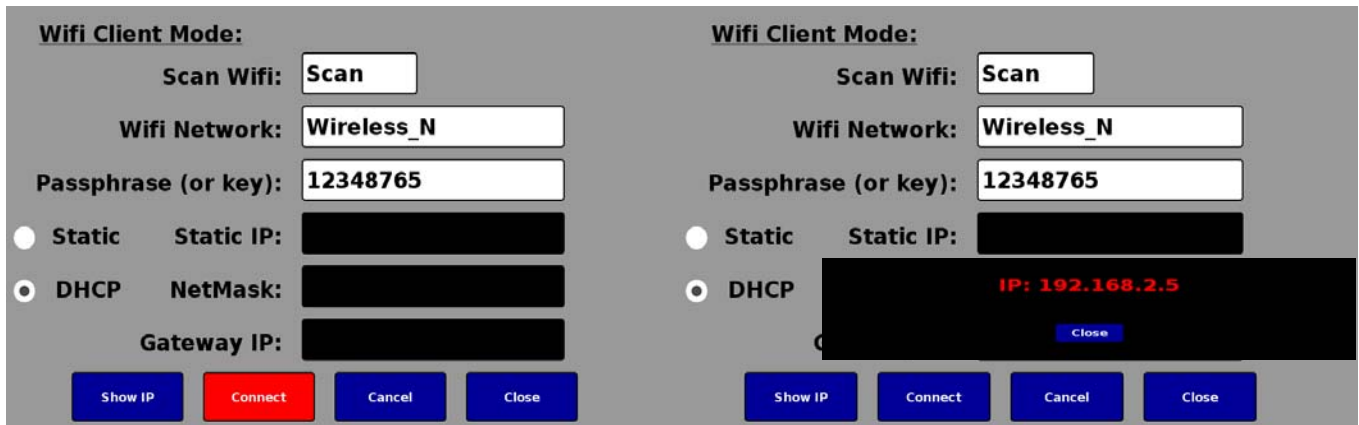


Figure 46

Figure 47

For WiFi Static (manual) configuration, pick the Static connection circle.

- 1) Press the Static IP box ( Figure 48 ) , a keypad box will open, press the CLR clear button and enter your IP address and hit ENT enter ( Figure 49).
- 2) Press the Netmask box ( Figure 48 ) a keypad box will open, press the CLR clear button and enter your Netmask address and hit ENT enter ( Figure 49).
- 3) Press the Gateway IP box ( Figure 48 ) a keypad box will open, press the CLR clear button and enter your Gateway IP address and hit ENT enter ( Figure 49). Note: If configuring a STATIC IP for WiFi or Ethernet and there is NO Gateway, then enter 0.0.0.0 for Gateway address.

**NOTE:** After any WiFi configuration you must **Restart** the display from the **Main Menu** button 8 shown on page 10 to access the IP address.

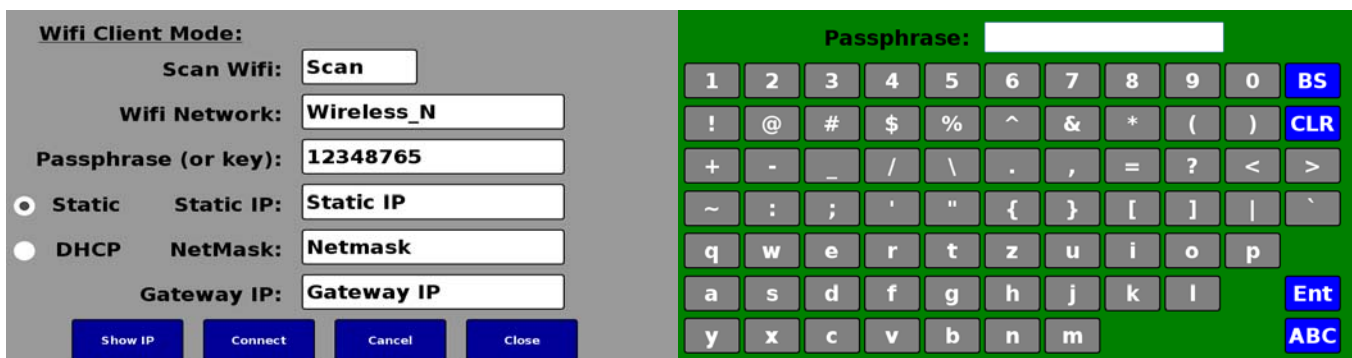


Figure 48

Figure 49

# COMPUTER MODE SCREEN

If you are running the EMS LabView software, power down the analyzer and flip the toggle switch in the back of the analyzer to computer mode (Figure 50). Connect your serial cables and power up the analyzer to run the software. The display screen will show a message to “ Disconnect from computer” with a world pic while in computer mode (Figure 51). Note: If the display only shows “ Disconnect FROM COMPUTER ” (Figure 51), check the “Display/Computer” switch on the back of the analyzer. The switch should be in the right position for display mode.



Figure 50



Figure 51

# Contacts Screen

Contacts Menu screen gives you all the contact info for EMS, website, email, payment address repair address and telephone #. NOTE: For repairs ship to the 480 Wright Dr. address.

**CONTACTS**

**Website:** [www.emsgas.com](http://www.emsgas.com)

**Email:** [sales@emsgas.com](mailto:sales@emsgas.com)

**US POST:** EMS  
P.O. Box 7086  
Algonquin, IL 60102 USA

**US POST:** Emission Systems Inc.  
480 Wright Drive  
Lake In The Hills, IL 60156

**Phone/Fax:** 847-669-8044

[Close](#)

# Help Screen

HELP Menu screen gives you the COMPLETE EMS operations and maintenance manual at your finger tips on the display for instant reference info.

**Help** [Zoom In](#) [Zoom Out](#) [Previous](#) [Next](#) [Close](#)

# EMS

EMISSIONS SYSTEMS, INC.

## Portable Exhaust Gas Analyzer Operators Manual

Model # 5003 (4 & 5 Gas) Live Reading only and  
Model # 8000 (Wireless)

# Maintenance

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 and extended life of the equipment . Specific maintenance procedures are described below:

## External Analyzer Maintenance:

1. The exhaust sample hose should be cleaned once a week (Figure 52). 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 plumbing 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 and the pumps turn off. If the analyzer does not hold vacuum, 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 distributor for assistance if required.

2. The External Filter should be checked often (Figure 53). 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 months High Performance Tuning would require a min. of once a month. To determine the correct replacement interval for your shop, check the filter once a month.

## Filter Replacement:

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 counterclockwise to tighten. Make sure the filter goes on straight, this is the most common point for leaks! Screw on filter bowl turning counterclockwise. Do a leak check after any filter change.



Figure 52



Figure 53



# Maintenance

## 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 12 screws, 5 on each side panel and two at the top behind the handle.

3. The Internal Filter is located inside the analyzer (Figure 54). 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 55). 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 O<sub>2</sub> sensor display can be monitored. If the reading drops below 17.0% the O<sub>2</sub> sensor should be replaced or with a volt meter when below 5 MV. Average O<sub>2</sub> sensor life is approx. 1 year. The oxygen sensor is located inside the analyzer.

- 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 55).
- Disconnect the two wire connector from the sensor. Rotate the sensor counter-clockwise.
- Install the new sensor, rotate clockwise until the o-ring seats. Reconnect the two wire connector. Replace the cover and power the analyzer. No additional steps are required.

5. NO<sub>x</sub> Sensor should be replaced as required (Figure 55). Replacement intervals will vary. A error will message will be displayed when the sensor needs to be replaced. The average life of a NO<sub>x</sub> sensor is approx. 3 years. Note: Contamination and large moisture content can reduce the life of No<sub>x</sub> sensors.

- 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 55).
- Disconnect the four wire connector from the sensor. Rotate the sensor counter-clockwise.
- Install the new sensor, rotate clockwise until the o-ring seats. Reconnect the four wire connector. Replace cover and power the analyzer. No additional steps are required.

**Internal Filter**



**Figure 54**

**O<sub>2</sub> Sensor and NO<sub>x</sub> Sensor**



**Figure 55**

# Maintenance

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; 180 DAY (6 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 counterclockwise to tighten. Make sure the filter goes on straight, this is the most common point for leaks! Screw on filter bowl turning counterclockwise. 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 Bad O2 model 5003 display.**

- 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. Reattach 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.

# Maintenance

## 4) NOX Sensor; part #: EMS-5065; 6 month min. re-calibration for accuracy and 2-3 Year Interval change out, or ERROR code Bad NOX 5003 model.

- NOX Sensors should re-calibrated a min of 6 month intervals. New NOX sensors require re-calibration as well as NOX accuracy checks.
- Calibration Bad Nox sensor message is a FALSE error, press Zero to clear!
- 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 clockwise, 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/Maintenance for Instrument Life. NOTE: Not performing these daily maintenance items could cause component failures that may not be covered under Warranty.

- Turn the 4 or 5 gas on in the morning in display mode and allow the instrument to warm up and get more stable running several hours before shutting the pumps down. 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 when your ready to use the analyzer as well as more stable readings.
- **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 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. The model 5003 has a leak check menu screen, go to this screen first. Plug the inlet quick connector on the analyzer for an internal leak check.
- 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.

# Maintenance

- Leak check failures would be if the 5003 model pumps turn on during the 30 seconds. The most common leak location is at the external filter bowl, this can be checked 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 coalescing filter, any yellowish or oil build up would require replacement. Make notes of how many tests have been performed so you can get a bench mark for your filter change out. 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. Afterwards, always allow the unit to purge out any contamination by running fresh air for as long as possible, or a minimum of 30 minutes or longer. This is the best thing to do after sampling any engine and will prolong the analyzer component life.

**OIL/WATER SEPARATOR:** The new High Performance Oil Water Separator, EMS-5151, has been added as our standard to remove more oil/water before the automatic drain water trap assembly. The separator should be drained daily by opening the drain valve on the oil/water reservoir daily. The Small Body Separator, EMS-5151, has a ball valve drain. The separator will work better in colder weather, however to enhance the capability of the separator in hot humid weather, EMS recommends to make a home made oil/water condenser by attaching a ICE bath. This can be done with a plastic cup filled with ice around the reservoir, or a spot cooler with compressed air. 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, 26 for detail pictures.



# Maintenance



**Small Body Oil/Water Separator EMS-5151**



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



**Spot Cooler with compressed air from "Exair"**



# Maintenance



## Dual Filter Upgrade for Production Sampling

- **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 in-line 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.



# Maintenance

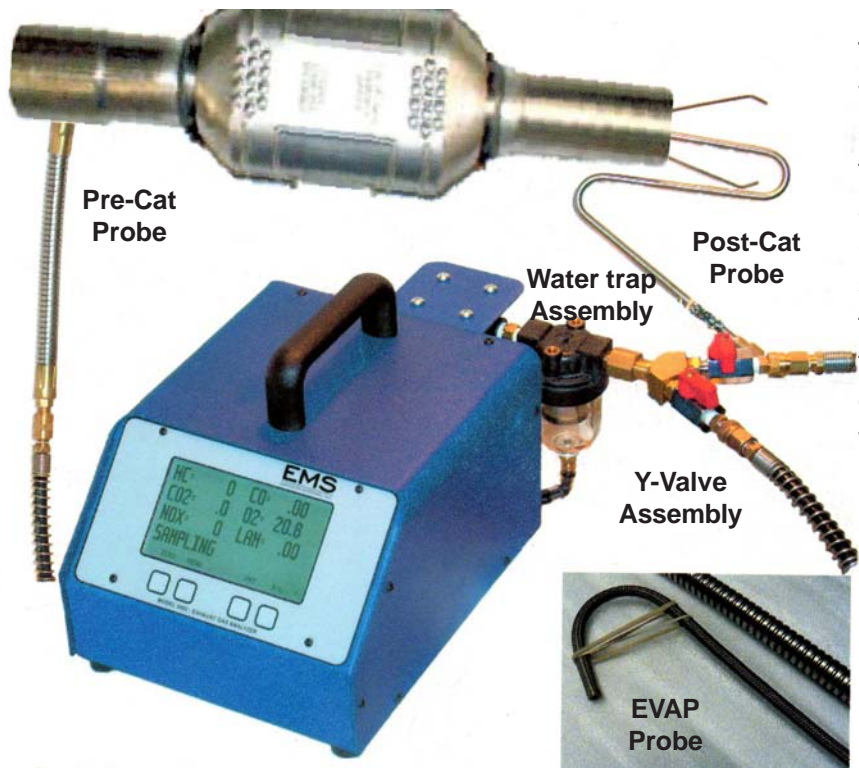
## Spare Parts and Accessories

### Part No: Description

EMS-5020: 12 VDC PUMP  
EMS-5032: 12 VDC HD SOLENOID VALVE  
EMS-5040: OPTICAL BENCH AMBII  
EMS-5041: OPTICAL BENCH AMBII REPAIRED  
EMS-5041: OPTICAL BENCH AMB REPAIRED  
EMS-5050: FLOW SWITCH  
EMS-5060: O2 SENSOR  
EMS-5065: NOX SENSOR  
EMS-5065-HP: NOX SENSOR High Performance  
EMS-5302: 5003 Display: 7-inch  
EMS-5306/5307: 500 POWER SUPPLY BOARD  
EMS-5093: INTERNAL FILTER  
EMS-5093 CS: INLINE FILTER Diesel Urea  
EMS-5093 CC: INLINE FILTER Carbon Absorber  
EMS-5096-25: 25'-0" EXHAUST HOSE  
EMS-5096-35: 35'-0" EXHAUST HOSE  
EMS-5097: EXHAUST HOSE HANDLE  
EMS-5098: EXHAUST PROBE STD.  
EMS-5098-1/4-20: THREADED PROBE  
EMS-5098: EVAP/SMALL ENGINE PROBE  
EMS-5099-HP 5.5 ft. Sample Hose 1/4" I.D.Teflon, S.S./Braid, 1/8 NPT Both Sides, 5.5 Ft. LG.  
EMS-5099-HP 11 ft. Sample Hose 1/4" I.D.Teflon, S.S./Braid, 1/8 NPT Both Sides, 11 Ft. LG.  
EMS-5500: CALIBRATION KIT  
EMS-5210: Power Cord w/ male socket  
EMS-5256: AC/DC Power Supply 5.5 AMP  
EMS-5257: USB to Serial Adapter 13"  
EMS-5258: DB9 Serial Cable 6 ft Long  
EMS-5259: DB9 Serial Cable 25 ft. Long  
EMS-5151: Small Body Oil/Water Separator  
EMS-5099-11ft HP Sample Hose Braided S.S.  
EMS-5099-5.5ft HP Sample Hose Braided S.S.  
EMS\_5370: Nylon Filter Housing; 1/4" NPT Ports w/ coalescing filter  
EMS\_5370-Assy: 1x EMS-5070; 1x EMS-5072 includes all fittings  
EMS-5370- Dual Assy: 2x EMS-5070; 1x EMS-5072 includes all fittings  
EMS-5371: Disposable Coalescing Filter Element; 99.5% efficient  
EMS-5372: Nylon Filter Housing; 1/4" NPT Ports., 1/8" NPT Drain  
EMS-5378-Banjo Sample Hose Assembly consisting of: M8x1 adaptor, M8x1 Banjo fitting, hose couplings, 11 ft. Braided S.S. Teflon sample hose  
EMS-5085-Y-Valve Assembly; w/ two ball valves & Male QD.  
EMS-5320-HP Assy.; O2 Sensor Bung M18 Sample Probe Assembly



# Diagnostic Accessories



The Y-Valve assembly (Fig. 56) was designed for pre-catalytic converter testing and dual exhaust testing. With the real benefit being able to hook up both pre & post cat sample hose & probes. And switch between both readings at the analyzer, which saves you time. Also check back pressure on the pre-cat side at the analyzer with our in-line pressure gauge (Fig.57)

EMS also offers a pop nut insert tool kit (Fig.58) 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. 59) is 3/16" O.D. and very flexible to help find radiator or exhaust leaks in tight spaces.



Figure 56



Figure 57



Figure 58

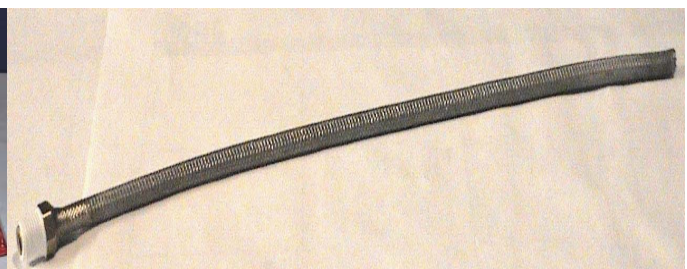


Figure 59

# 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 **18 Months**.

- 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 unit should be returned in the shortest possible time frame 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: \_\_\_\_\_

- Activation number: \_\_\_\_\_