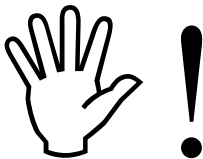# Installation Instructions for:

30-2300 Dual Channel &
30-2301 Single Channel
O2 Sensor Controller

WARNING:
This installation is not for the electrically or mechanically challenged! Use this sensor with <u>EXTREME</u> caution! If you are uncomfortable with anything about this, please refer the installation to an AEM trained tuning shop or call 800-423-0046 for technical assistance. You should also visit the AEM Performance Electronics Forum at http://www.aempower.com

NOTE: AEM holds no responsibility for any engine damage that results from the misuse of this product!

This product is legal in California for racing vehicles only and should never be used on public highways.

The Advanced Engine Management (AEM) Wideband O2 Sensor is designed for integration into vehicles already fitted with aftermarket ECU's or OBD port data loggers. It furnishes the user with real time, accurate and repeatable air/fuel ratio values. The system consists of the AEM UEGO controller with wiring harness and one or two Bosch wide range sensors with weld in sensor bungs. The controller is available as both a single or dual channel system with one UEGO sensor per channel.

Each O2 channel features two different analog outputs, a 0-5 volt signal and a 0-1 volt signal. The 0-1 volt is a "Lean to Rich" calibration specifically designed to simulate the output range of a narrow band type sensor. This can be fed into a stock ECU to keep from generating a failure code in the ECU. It can also be used on older aftermarket ECU's that expect a 0-1 volt narrow band type signal.

AEM's O2 Sensor Kit (single channel shown)

The UEGO controller's ultra-compact size can be mounted in the engine compartment or under the dashboard. It is very light and can easily be mounted with the supplied Velcro strips. The

UEGO controller should be mounted as flat as possible and should not be in a place where it will be subjected to shock, water, or extreme heat.

There are either two (30-2301) or three (30-2300) connectors protruding from the box. The long black cable(s) connect to the oxygen sensor(s). Ensure the routing to the sensor will not come in close contact with the exhaust. The 6 pin (8-pin on the 30-3300) rectangular connector plugs into the Power/Output harness. This connector provides power to the controller unit and also contains the sensor output(s).

These can be connected to the AEM Engine Management System (EMS) or many other standalone engine management systems. When connecting to the EMS, the UEGO AMP outputs should be connected to the O2 #1 or O2 #2 inputs. Make sure to verify that the O2 #1(#2) Gain (option) is set so the voltage from the O2 #1(#2) Volts (parameter) matches the voltage input at the EMS from the O2 sensor. An easy way to do this is to disconnect the UEGO sensor from the UEGO controller. When in this state, the UEGO controller will output 4.00 volts. You can then adjust the O2 #1 Gain (or O2 #2 Gain) until the O2 #1 Volts (or O2 #2 Volts) display in AEMPro reads 4.00 volts.

The black wire is to be connected to battery negative (do not use the chassis as the power ground). The red wire is for switched +12 volts. This wire should be powered only when the ignition switch is "on".

When connecting to an AEM EMS, use the following pins for O2 #1 & O2 #2:

AEM EMS P/N	O2 #1 Pin	O2 #2 Pin
30-1000	D14	D16
30-1001	D14	D16
30-1002	D14	D16
30-1010	C16	C15
30-1012	C16	C15
30-1020	D7	D14
30-1100	B47	B48
30-1101	B47	B48
30-1120	B6	B14
30-1121	B6	B14
30-1130	B6	B14
30-1300	4	66
30-1310	76	75
30-1311	76	75
30-1312	76	75
30-1313	76	75
30-1400	29	43
30-1401	44	43
30-1710	2N	4J
30-1720	C3	D3
30-1800	C3	A2

When connecting to a third party engine management system, the 0-5 volt or 0-1 volt output should be connected to the analog O2 input of the ECU. Consult the documentation provided with your ECU for detailed instructions.
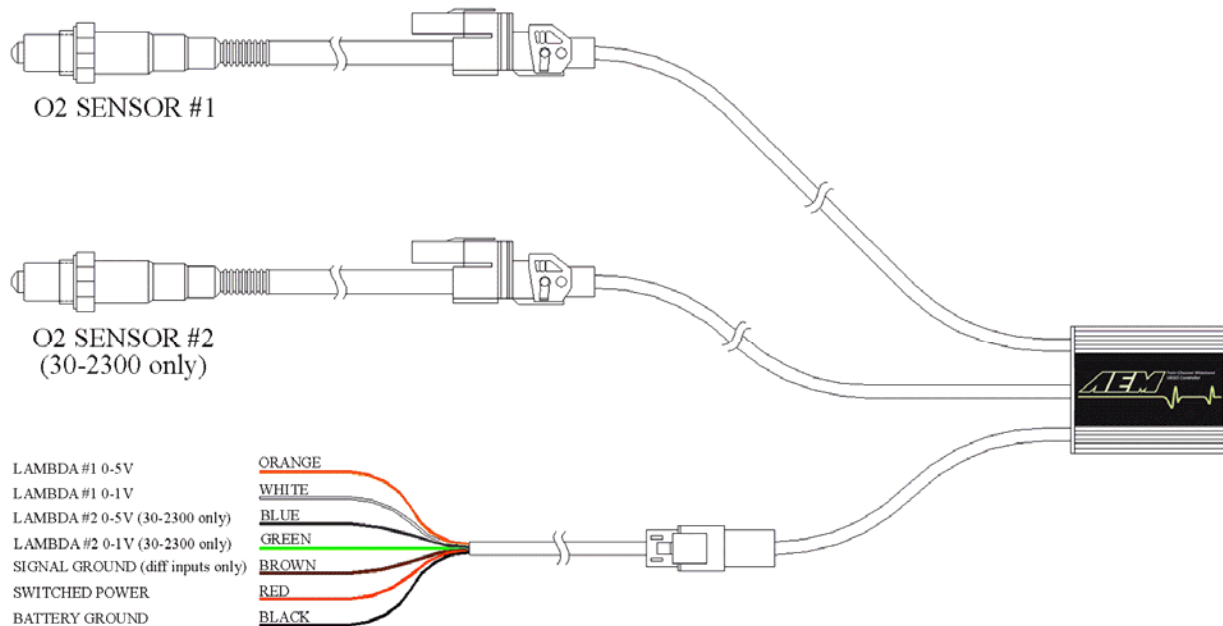

Installing the AEM Wideband O2 sensor kit

The 5 (7 on the 30-3300) wires should be hooked up as follows:

Orange	Sensor #1 0-5 Volt Output
White	Sensor #1 0-1 Volt Output
Blue	Sensor #2 0-5 Volt Output (on 30-2300 only)
Green	Sensor #2 0-1 Volt Output (on 30-2300 only)
Brown	Signal Ground (use only on systems with a differential input, not the AEM EMS)
Red	Switched +10 to +18 Volts (10 Amp Fuse Required)
Black	Battery Ground

Oxygen Sensor

Typical production car O2 sensors rely on "nernst cell" technology, commonly called "Narrow Band", "2 wire", "4 wire" and sometimes erroneously described as "Wide Band". This is a very cost effective method that outputs a voltage based on the oxygen content of the gas being sampled. It is accurate in the region surrounding stoichiometric operation and leaner. Unfortunately, in the rich region where high performance engines usually operate, their accuracy and repeatability is virtually non-existent.
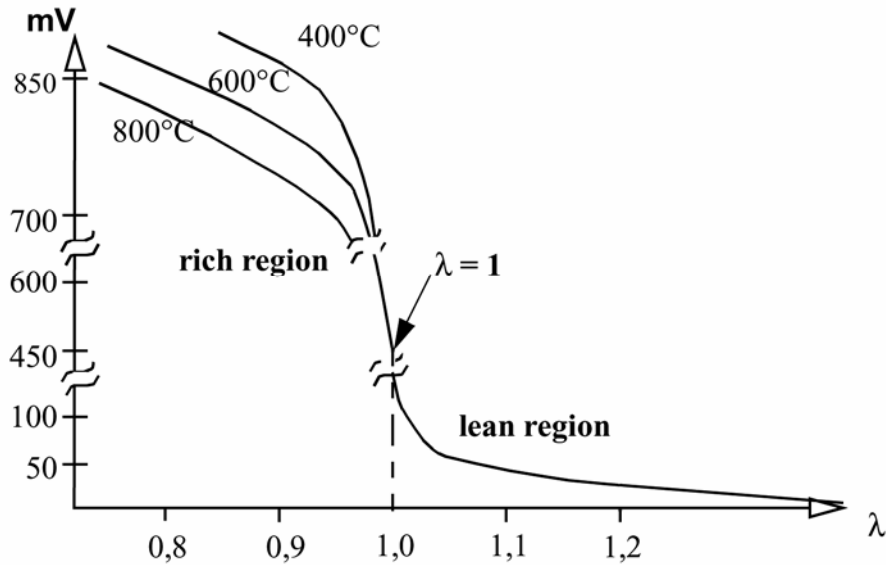
Characteristic curve of an nernst cell type O2 Sensor

The rich region output of a common O2 sensor is very temperature dependant, which renders it useless if an accuracy greater than 1.5:1 AFR is desired. This is immediately obvious given the fact that a single output voltage actually represents wildly different AFR's depending on the unregulated and unmeasured sensor temperature. These sensors were designed for operating closed loop around the stoichiometric AFR (14.64 for gasoline), and for performance tuning they are useless.

The heart of the AEM Wideband controller is the Bosch LSU4.2 Universal Exhaust Gas Oxygen (UEGO) sensor. This type of sensor is commonly referred to as "laboratory grade" and works on a different principle than the normal oxygen sensor you would find in your car. Its unique design makes precision AFR measurement possible over the entire operating range.

UEGO type sensors use a "current pump" within the sensor itself to determine the actual oxygen concentration within the sensing element or, lacking any O2, it determines the amount of oxygen required to regain stoichiometric operation. The output is in the form of a very small current which varies depending on the air-fuel ratio. This is completely different from a normal oxygen sensor (1, 2 and 4 wire types) which directly output a voltage. The UEGO design allows measurement of the exact air fuel ratio over the entire operating range.
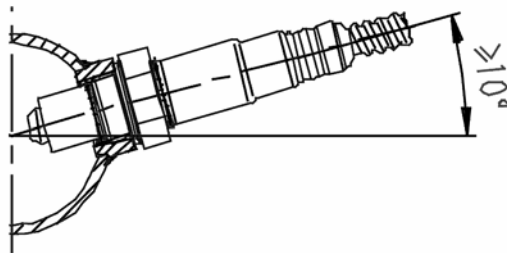
Each AEM UEGO sensor is individually calibrated and a resistor integral to the connector body is laser trimmed with this value. This process replaces the traditional "free air" calibration procedure when changing sensors and implements a sensor specific calibration for unparalleled accuracy.
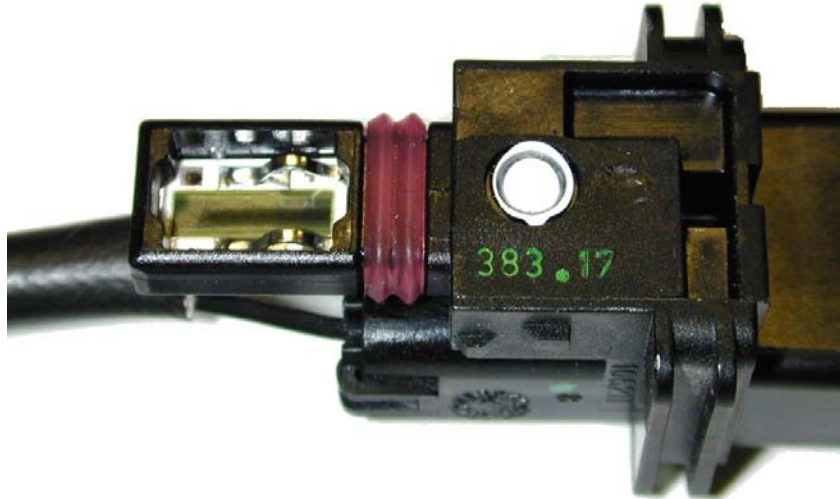
UEGO sensors laser etched calibration resistor

Sensor Placement

  A weld-in M18 X 1.5 boss is supplied for sensor installation. Mount the O2 sensor in the exhaust system at least 18 inches downstream from the exhaust port. If you anticipate high EGT's (over 800C), run a turbocharger, run at high RPM for extended periods of time or plan on running leaded race fuel then you must mount the sensor at least 36 inches or more downstream of the exhaust port as all of these can cause the sensor to overheat. On turbocharged engines the UEGO sensor must be installed after the turbo charger, if not, the pressure differential will greatly effect the accuracy of the unit. In applications with a catalytic converter, the UEGO sensor must be mounted BEFORE the converter. In applications with an auxiliary air pump, the UEGO sensor must be mounted BEFORE the pump input to the exhaust stream. Installation angle should be inclined at least 10° towards horizontal (electrical connection upwards, see diagram) which prevents the collection of liquids between sensor housing and sensor element during the cold start phase.

Minimum mounting angle for the UEGO Sensor

Volts	Lambda 0-5V	AFR 0-5V	Volts	Lambda 0-1V	AFR 0-1V
0.00	0.57	8.41	0.48	1.41	20.64
0.16	0.58	8.52	0.49	1.29	18.89
0.31	0.59	8.64	0.51	1.19	17.42
0.47	0.60	8.81	0.52	1.13	16.54
0.62	0.61	8.98	0.54	1.08	15.81
0.78	0.62	9.09	0.55	1.03	15.08
0.94	0.63	9.26	0.57	1.00	14.64
1.09	0.64	9.44	0.58	0.98	14.35
1.25	0.66	9.61	0.59	0.96	14.05
1.40	0.67	9.78	0.61	0.94	13.76
1.56	0.68	9.95	0.62	0.92	13.47
1.72	0.69	10.12	0.64	0.90	13.18
1.87	0.70	10.29	0.65	0.88	12.88
2.03	0.72	10.47	0.67	0.87	12.74
2.18	0.73	10.69	0.68	0.85	12.44
2.34	0.75	10.92	0.70	0.84	12.30
2.50	0.76	11.15	0.71	0.82	12.00
2.65	0.78	11.38	0.72	0.81	11.86
2.81	0.80	11.67	0.74	0.79	11.57
2.96	0.82	11.95	0.75	0.77	11.27
3.12	0.84	12.24	0.77	0.76	11.13
3.28	0.86	12.58	0.78	0.74	10.83
3.43	0.88	12.92	0.80	0.73	10.69
3.59	0.91	13.27	0.81	0.71	10.39
3.74	0.93	13.67	0.83	0.70	10.25
3.90	0.97	14.13	0.84	0.68	9.96
4.06	1.00	14.64	0.86	0.67	9.81
4.21	1.04	15.21	0.87	0.66	9.66
4.37	1.08	15.84	0.88	0.64	9.37
4.52	1.13	16.53	0.90	0.62	9.08
4.68	1.18	17.27	0.91	0.61	8.93
4.84	1.24	18.19	0.93	0.59	8.64
4.99	1.33	19.44	0.94	0.58	8.49

0-5 volt and 0-1 volt analog output calibrations

Gasoline AFR = Lambda * 14.64
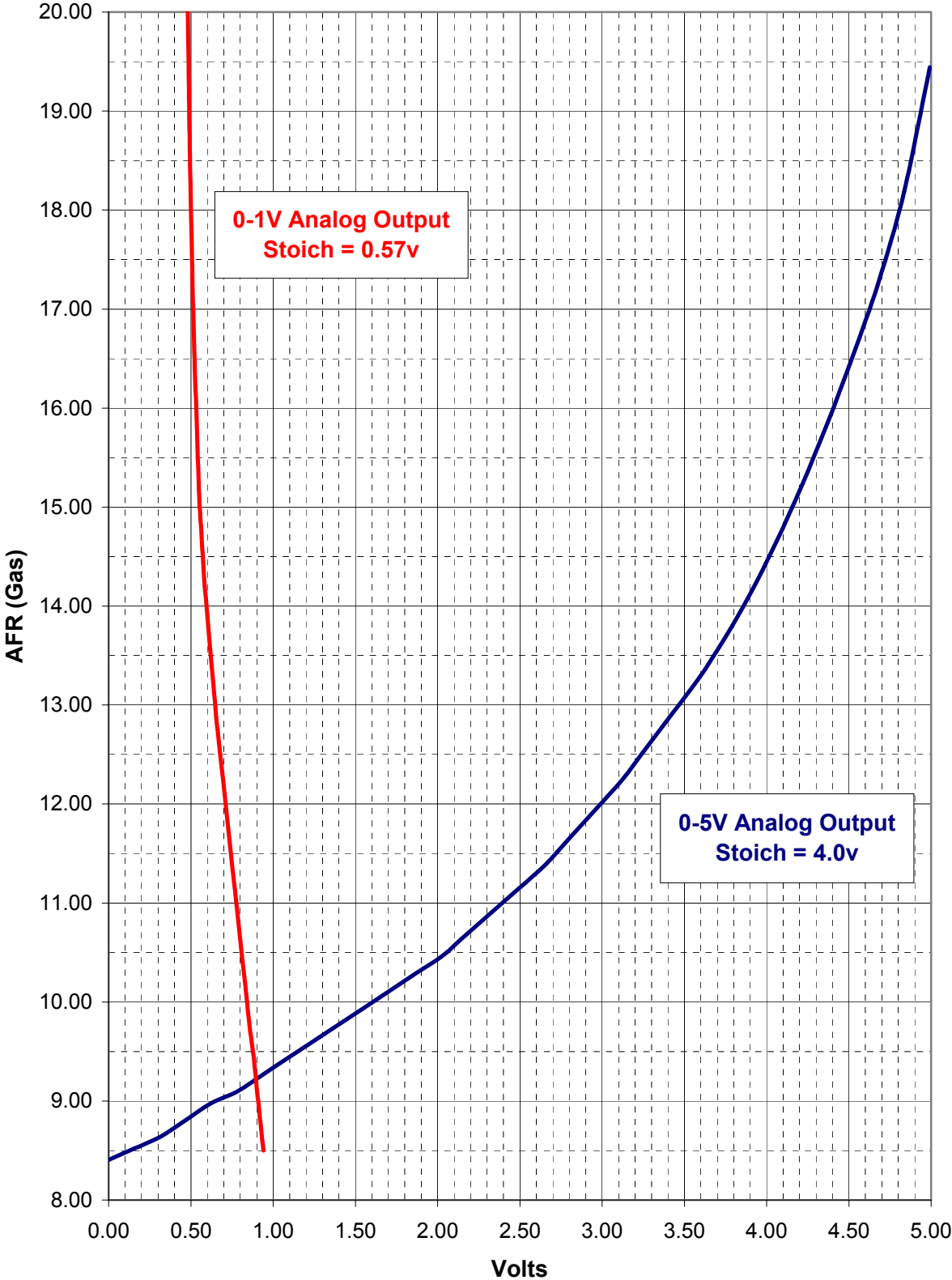Methanol AFR = Lambda * 6.47
Diesel AFR = Lambda * 14.5
Propane AFR = Lambda * 15.7
Ethanol AFR = Lambda * 9.00
CNG AFR = Lambda * 14.5

Calculating the Air Fuel Ratio of common fuels from the Lambda value

Air Fuel Ratio (AFR) vs Output Voltages

0-1V Analog Output
Stoich = 0.57v

0-5V Analog Output
Stoich = 4.0v

SPECIFICATIONS:

Controller

	30-2301	30-2300
	9 to 18 Volts	
Supply Current (nominal):	1.3 amps	2.6 amps
UEGO Sensor Inputs:	1	2
0-5v "Rich to Lean" analog outputs:	1	2
0-1v "Lean to Rich" analog outputs:	1	2
Measuring Range:	0.55 to 1.3 Lambda	
Harness & Connector Temp Limit:	120 C	

Sensor

Type:	Bosch UEGO LSU4.2
Accuracy:	+/- 0.7%
Exhaust Temp Limit:	1030 C
Cable & Protector Sleeve Temp Limit:	250 C
Connector Temp Limit:	120 C
Initial Warm-up Time:	Less than 20 seconds
Weight:	80 grams
Heater Current:	1.2A at 12.0V (each sensor)
Mounting:	M18 X 1.5 thread, Torque to 30 ft-lbs
Nominal Service Life:	80,000 km for Unleaded Fuel
	50,000 km for Leaded Fuel 0.15g Pb/l
	20,000 km for Leaded Fuel 0.40g Pb/l
	10,000 km for Leaded Fuel 0.60g Pb/l

Notes:
The sensor contains a ceramic module and should not be subject to mechanical or thermal shock or it may be damaged.
The sensor is not designed for operation on leaded fuels, doing so will dramatically shorten sensor life.
Long term running in the rich region (Lambda < 0.95) will shorten sensor life.
High exhaust temperatures (over 850C) will shorten sensor life.
Engine oil consumption at a rate greater than 1 quart per1,000 miles will shorten sensor life.
Do not run the engine with the UEGO sensor installed without power applied to the controller and the sensor plugged in.

PARTS LIST:

Dual Channel UEGO Sensor Kit, P/N 30-2300
1 x Dual Channel UEGO Controller
2 x UEGO Sensor
1 x Flying Lead Harness
2 x O2 Sensor Bung & Plug
2 x AEM Stickers
1 x Velcro

Single Channel UEGO Sensor Kit, P/N 30-2301
1 x Single Channel UEGO Controller
1 x UEGO Sensor
1 x Flying Lead Harness
1 x O2 Sensor Bung & Plug
2 x AEM Stickers
1 x Velcro

REPLACEMENT OXYGEN SENSOR COMPONENTS
30-2001   Replacement UEGO Sensor (requires 30-2300 or 30-2301 controller to use)
35-4005   O2 Sensor Bung, mild steel, welding required
35-4001   O2 Sensor Plug, mild steel

12 MONTH LIMITED WARRANTY

Advanced Engine Management Inc. warrants to the consumer that all AEM High Performance products will be free from defects in material and workmanship for a period of twelve (12) months from date of the original purchase. Products that fail within this 12 month warranty period will be repaired or replaced at AEM's option, when determined by AEM that the product failed due to defects in material or workmanship. This warranty is limited to the repair or replacement of the AEM part. In no event shall this warranty exceed the original purchase price of the AEM part nor shall AEM be responsible for special, incidental or consequential damages or cost incurred due to the failure of this product. AEM does not warranty the UEGO sensor, please contact Bosch directly for warranty claims. Warranty claims to AEM must be transportation prepaid and accompanied with dated proof of purchase. This warranty applies only to the original purchaser of product and is non-transferable. All implied warranties shall be limited in duration to the said 12 month warranty period. Improper use or installation, use for racing, accident, abuse, unauthorized repairs or alterations voids this warranty. AEM disclaims any liability for consequential damages due to breach of any written or implied warranty on all products manufactured by AEM. Warranty returns will only be accepted by AEM when accompanied by a valid Return Goods Authorization (RGA) number. Credit for defective products will be issued pending inspection. Product must be received by AEM within 30 days of the date RGA is issued.

Please note that before we can issue an RGA for an EMS or UEGO System, it is first necessary for the installer or end user to contact our EMS tech line at 1-800-423-0046 to discuss the problem. Most issues can be solved over the phone. Under no circumstances should a system be returned or RGA requested before the above process transpires.