

# Toxgard<sup>®</sup> II Monitor

## Instruction Manual

### WARNING

THIS MANUAL MUST BE CAREFULLY READ BY ALL INDIVIDUALS WHO HAVE OR WILL HAVE THE RESPONSIBILITY FOR USING OR SERVICING THE PRODUCT. Like any piece of complex equipment, this device will perform as designed only if it is used and serviced in accordance with the manufacturer's instructions. OTHERWISE, IT COULD FAIL TO PERFORM AS DESIGNED AND PERSONS WHO RELY ON THIS PRODUCT FOR THEIR SAFETY COULD SUSTAIN SEVERE PERSONAL INJURY OR DEATH.

The warranties made by Mine Safety Appliances Company with respect to the product are voided if the product is not used and serviced in accordance with the instructions in this manual. Please protect yourself and others by following them. We encourage our customers to write or call regarding this equipment prior to use or for any additional information relative to use or service.

In the U.S., to contact your nearest stocking location, dial toll-free 1-800-MSA-INST  
To contact MSA International, dial 724-776-8626.

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Manufactured by

## MSA NORTH AMERICA

1000 Cranberry Woods Drive, Cranberry Township, PA 16066

## MSA Permanent Instrument Warranty

- 1. Warranty-** Seller warrants that this product will be free from mechanical defect or faulty workmanship for a period of eighteen (18) months from date of shipment or one (1) year from installation, whichever occurs first, provided it is maintained and used in accordance with Seller's instructions and/or recommendations. This warranty does not apply to expendable or consumable parts whose normal life expectancy is less than one (1) year such as, but not limited to, non-rechargeable batteries, sensor elements, filter, lamps, fuses etc. The Seller shall be released from all obligations under this warranty in the event repairs or modifications are made by persons other than its own or authorized service personnel or if the warranty claim results from physical abuse or misuse of the product. No agent, employee or representative of the Seller has any authority to bind the Seller to any affirmation, representation or warranty concerning the goods sold under this contract. Seller makes no warranty concerning components or accessories not manufactured by the Seller, but will pass onto the Purchaser all warranties of manufacturers of such components. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO THE TERMS HEREOF. SELLER SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**
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- 3. Exclusion of Consequential Damage-** Purchaser specifically understands and agrees that under no circumstances will seller be liable to purchaser for economic, special, incidental or consequential damages or losses of any kind whatsoever, including but not limited to, loss of anticipated profits and any other loss caused by reason of non-operation of the goods. This exclusion is applicable to claims for breach of warranty, tortious conduct or any other cause of action against seller.

## WARNINGS

1. Each instrument described in this manual must be installed, operated and maintained in strict accordance with its labels, cautions, warnings, instructions, and within the limitations stated.
2. These monitors must not be installed in areas or locations where explosive concentrations of combustible gases or vapors might occur in the atmosphere: Class 1, Group A, B, C, and D areas as defined by the NEC. Since the monitors are not explosion-proof, they must be located in non-hazardous areas.
3. The Toxgard II monitor is designed to detect toxic gases or vapors in the air. It cannot measure the concentration of toxic gases or vapors in steam or inert or oxygen-deficient atmospheres. Neither will it indicate the presence of explosive or combustible mists or sprays, lubrication oils, nor explosive dusts, such as grain or coal dust.
4. As with all gas detection instruments of this type, high levels of or long exposure to certain compounds - all of which are not known, will contaminate the sensor. Calibrate the monitor frequently to ensure that system operation is dependable and its indications accurate.
5. The Toxgard II monitor must not be painted. Also, painting should not be done near the sample line inlet. If painting is being done in an area where the sample line inlet is located, care must be exercised to make sure that paint is not deposited on the sample inlet fitting of the monitor. Such paint deposits would interfere with the sampling process, whereby a sample of the atmosphere being monitored is drawn into the Toxgard II unit.
6. The only absolute method to ensure proper overall operation of a gas detection instrument is to check it with a known concentration of the gas for which it has been calibrated. Consequently, a calibration check should be included as part of the routine inspection of the system.
7. The sensor is a sealed unit which contains an electrolyte. Should the sensor develop leakage, it should be immediately removed from the sensing head and properly discarded in accordance with local, state and federal laws. To obtain a replacement sensor, contact MSA at the address given in Chapter 5, "Obtaining Replacement Parts." Caution must be exercised so that the electrolyte does not contact skin eyes, clothing or circuitry. Get immediate medical attention if electrolyte contacts skin or eyes.

Perform periodic leak check on the sample line and all flow system components and fittings of the Toxgard II monitor.

9. Use only genuine MSA replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair instrument performance. Repair or alteration of the Toxgard II unit, beyond the scope of these maintenance instructions, or by anyone other than an authorized MSA serviceman, could cause the product to fail to perform as designed, and persons who rely on this product for their safety could sustain severe personal injury or death.
10. Properly vent the exhaust of the Toxgard II monitor to a safe area. Improper venting of the exhaust can cause personal injury or death.
11. Do not install additional filters into the sample inlet fittings. Adding the filters will impair instrument performance.
12. Ensure the gas sample and Toxgard II unit are at the same temperature; otherwise, condensation will form, possibly clogging or filling the sample line.
13. Do not mix units with different area classifications. All units used in a classified area must have the proper area classification. Otherwise, an explosion hazard exists, resulting in possible explosion, injury or death.

**FAILURE TO FOLLOW THE ABOVE WARNING CAN RESULT IN  
SERIOUS PERSONAL INJURY OR DEATH.**

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# Chapter 1, Set-up

## Unpacking Your Unit

Several cartons may arrive with your order; locate the carton(s) marked as the Toxgard II Monitor. Upon receipt, ensure that your package contains:

- Toxgard II Monitor (FIGURE 1-1)
  - Toxgard II Monitor Instruction Manual (P/N 711266).  
If your unit is a Toxgard II Monitor with Digital Output, there will be an additional manual (P/N 711203)
  - Toxgard II Remote Sensor Module, if ordered as a Remote Sensor model (FIGURE 1-2)
1. Remove the Toxgard II unit from its shipping container(s), taking care not to damage sensitive electrical components.
  2. Search through the packing material and the containers to avoid discarding valuable parts.

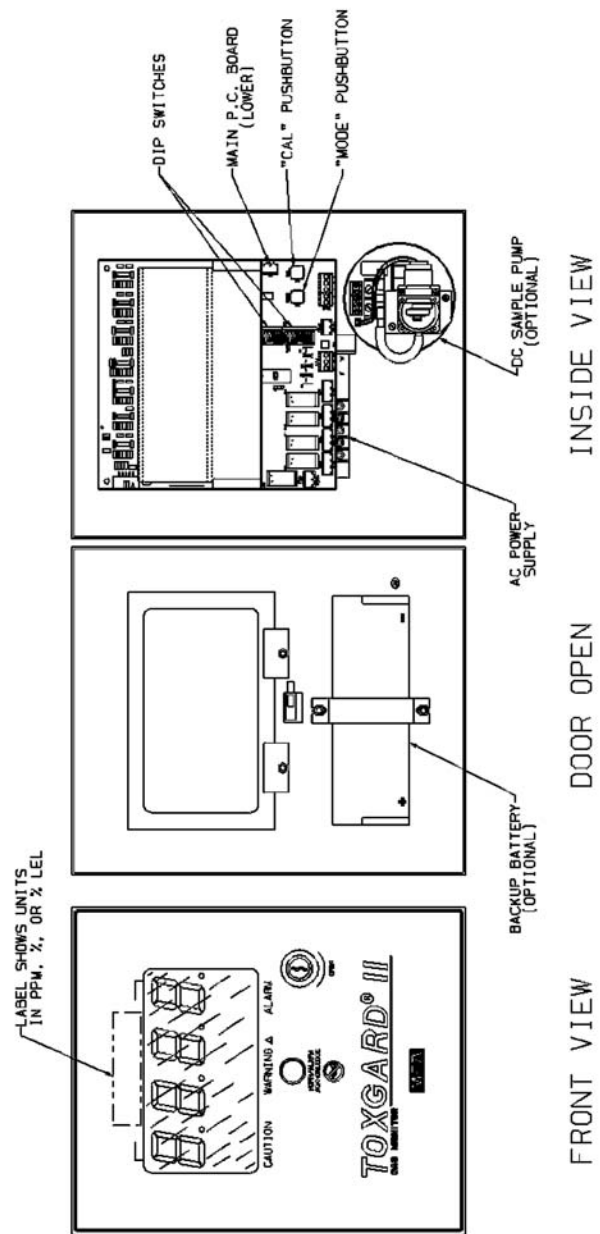
## Initial Inspection

1. Turn the coin slot lock 1/4-turn clockwise and open the door or use the key for the key lock, if so equipped.
2. Carefully inspect the components and assemblies inside the case. If damage or shortage is noted, advise the carrier promptly; make the proper claim with the carrier.

## General Description

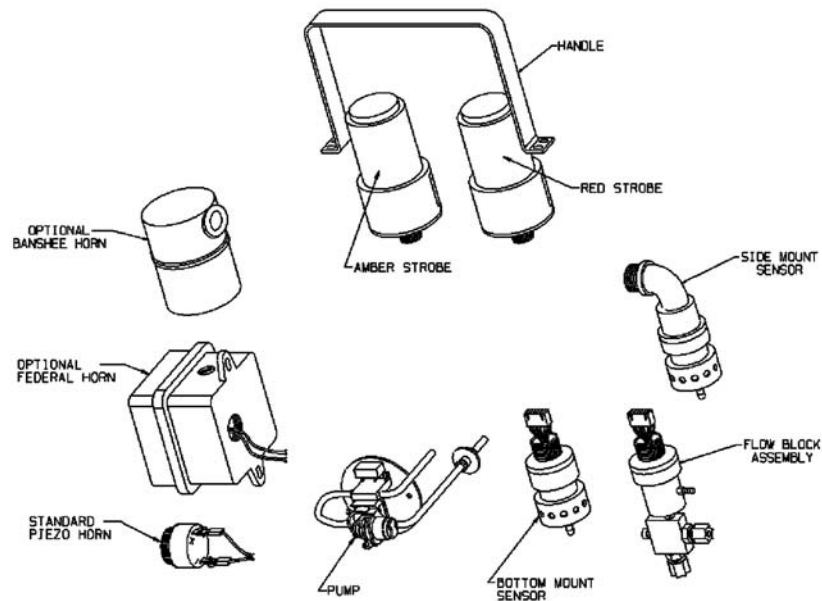
The Toxgard II Monitor is an easy-to-use, low-cost, one-sensor monitor. It is designed to sample the environment where the monitor is mounted and to alert you to potentially dangerous levels of one of the following gases, depending on your particular model:

- |                    |                     |
|--------------------|---------------------|
| • Combustible gas  | • Hydrogen Cyanide  |
| • Oxygen           | • Hydrogen Chloride |
| • Carbon Monoxide  | • Nitric Oxide      |
| • Hydrogen Sulfide | • Nitrogen Dioxide  |
| • Chlorine         | • Sulfur Dioxide    |
| • Chlorine Dioxide |                     |



**Figure 1-1. Toxgard II Monitor**





**Figure 1-4. Options and Accessories**  
(Battery Back-up not shown)

## Mounting Your Gas Monitor

Generally, the unit or the remote sensing module should be mounted close to the area where a leak is likely to occur or where the gas is expected. The Toxgard II Monitor or Remote Sensing Module should be installed at a high level (ceiling), breathing level or low level (floor), depending on the density of the gas being monitored. Mount the unit so that the front display is not blocked or hidden from view.

### **⚠ WARNING**

Do not locate the Toxgard II Monitor in an area which may contain a flammable mixture of gas and air; otherwise, an explosion may occur.

The general-purpose Toxgard II Monitor can be a source of ignition and must not be mounted in an area where a flammable mixture of combustible gas and air may be present; otherwise, an explosion may occur.

Mount the Toxgard II Monitor or the Remote Sensing Module with its sensor inlet fitting (FIGURE 1-1 or 1-2) pointed downwards; otherwise, the inlet may become clogged with particulate matter or liquids. Do not paint the Toxgard II Monitor. If

painting is done in an area where a sensor is located, exercise **CAUTION** to ensure paint is not deposited on the sensor inlet fitting. Such paint deposits would interfere with the diffusion process, whereby a sample of the monitored atmosphere diffuses into the sensor. Failure to follow the above can result in serious personal injury or death.

**⚠ CAUTION**

**Protect the Toxgard II Monitor from extreme vibration. Do not mount the sensing head in direct sunlight as this may cause the sensor to overheat.**

Ventilation patterns must be established before positioning the Toxgard II unit or sensor assembly. Smoke tubes (P/N 458481) are useful in measuring the direction and rate of air flow to determine areas where the gas of interest may tend to accumulate.

Using suitable hardware (not supplied), mount the Toxgard II monitor to any flat surface via its four mounting lugs (see FIGURE 1-6). Allow sufficient room to open the unit front door.

The Toxgard II unit is designed to meet NEMA 4X requirements, suitable for many damp, wet and/or outdoor locations.

## **Gas Sampling Options**

Although the Toxgard II unit normally operates in the diffusion mode (i.e., gases or vapors to be detected enter the sensor input by natural molecular diffusion), a sample can be drawn into the instrument if the DC pump or air aspirator option was purchased.

### **The Toxgard II Pump or Aspirator Model:**

- draws a gas sample from the monitored area, through a sample line (available separately) to the Toxgard II Gas Monitor sensor
- samples areas that are remote, inaccessible, too hot or too cold for direct sensor monitoring, such as:
  - ducts carrying combustible or toxic gas
  - wet wells
  - printing drying ovens
  - blanking or inerting operations
- has electronics physically located in the main monitor enclosure (FIGURE 1-1)

- comes equipped with a special flow cap for use on the Toxgard II Gas Monitor to ensure proper sensor sampling.
- provides notification via the Toxgard II Monitor LED display and fault relays if a flow fault is detected.

**Table 1-1. Performance Specifications for Toxgard II Pump or Aspirator Model**

<b>SAMPLE TRANSPORT TIME</b>	30 seconds at 0.5 lpm with 50 feet (15.25 meters) of .180 (4.57 mm) ID sample tubing
<b>NOMINAL SAMPLE FLOW RATE</b>	2 CFH (1 LPM)
<b>MINIMUM SAMPLE FLOW RATE</b>	1 CFH (.500 LPM)
<b>MAXIMUM SAMPLE TUBING LENGTH</b>	100 feet (30 meters); 3/16" ID (4.76 mm) 25 feet (7.5 meters) maximum for Chlorine, Nitrogen Dioxide and Chlorine Dioxide
<b>MAXIMUM EXHAUST TUBING LENGTH</b>	20 feet (6 meters)
<b>INLET FITTINGS</b>	1/4" (6.35 mm) OD Tube Fitting
<b>EXHAUST FITTING</b>	1/4" (6.35 mm) OD Tube Fitting

**⚠ WARNING**

Only Remote Sensors with proper area ratings can be used in a hazardous area. The Toxgard II Monitor cannot be installed in a hazardous area. Otherwise, an explosion hazard will exist, resulting in a possible explosion, injury or death.

## Installation of DC Pump or Aspirator Sampling Sample Line Placement

1. Remove all protective packaging plugs and/or caps from gas INLET, CALIBRATION and EXHAUST PORTS.
  - In-line filter must be used in the sample line.
  - MSA tubing is available (P/N 600771).

The pump or aspirator draws a gas sample to the Toxgard II Gas Monitor sensor (FIGURE 1-1):

- Can be extended up to 100 feet (30 Meters) away from the Toxgard II Gas Monitor.



- Uses 1/4-inch (6.35 mm) OD tubing. The tubing must be compatible with the sampled gas. Sample tubing must also be 3/16" ID for 100-foot lines to prevent "Lo Flo."
- It takes a maximum of 30 seconds for the sample gas to reach the Toxgard II Gas Monitor when 50 feet (15.25 meters) of tubing is used:
  - To decrease this time, shorten the sample line length.
  - It is generally good practice to make the sample line as short as possible.
- Depending on the gas characteristics, the end of the sampling tubing and the sample inlet should be mounted to best optimize sampling of that particular gas. Consult your architect, facility manager or safety engineer for guidance in proper placement of the sampling tube inlet.
- Testing for ventilation patterns is useful in establishing sample inlet location. Smoke tubes (P/N 458481) are useful in measuring the direction and rate of air flow to determine which areas to monitor.
- A particulate filter (purchased separately) should be used at the inlet end of the sample line to help prevent dirt and dust from clogging the sample line. This filter must be compatible with the gas being sampled.
- It is recommended that a stainless steel or Teflon\* sample line be used for monitoring gases that are highly reactive such as:
  - Nitrogen Dioxide
  - Sulfur Dioxide.
- Use only a Teflon sample line for the following gases:
  - Chlorine
  - Chlorine Dioxide
  - Hydrogen Chloride
  - Ammonia.
- With the above gases, do not use an end-of-line filter. The sample line should be inspected periodically and replaced if dirty. Do not attempt to clean the sample line by applying compressed air.

NOTE: Do not run the sample tubing in water or across areas of vibration, doorways, man ways or access ways; otherwise, a sample tubing leak or tripping hazard may result.

2. Using suitable hardware (not supplied):
  - Fasten the sample tubing to supports.
    - Do not tightly pinch the tubing; otherwise, flow may be restricted.
  - Fasten the end of the sample tubing and sample inlet in the monitoring area.
    - The sample inlet should be pointed downward to prevent dirt and water from entering the sample tubing line.
3. Install the end-of-line filter at the end of the sampling tubing.
4. Check for leaks along the entire length of the sample tubing line. Any leak will dilute the gas sample from the area of interest and give a lower than actual gas reading.

## Exhaust Line Placement

1. **For DC pump only:**

Attach 1/4-inch (6.35 mm) OD sample tubing to the exhaust outlet fitting.

**For Aspirated systems only:**

Attach 3/8-inch (9.52 mm) OD sample tubing to the exhaust outlet fitting.
2. Route the exhaust tubing into a safe area where the gas sample can be vented. Avoid any sharp bends or elbows. Route the tubing to allow any collected water to drain.
  - The maximum exhaust tubing length is 20 feet (6 meters).

NOTE: Do not run the exhaust tubing in water or across areas of vibration or across doorways, man ways or access ways; otherwise, a leak in the exhaust tubing or a tripping hazard may result.
3. Fasten the exhaust tubing to supports using suitable hardware (not supplied).
4. Fasten the end of the exhaust tubing in the area of interest by using suitable hardware (not supplied).
  - Exhaust inlet should be pointed downward to prevent dirt and water from entering the exhaust tubing line.

NOTE: Exhaust to a safe or non-hazardous area only.
5. Check for leaks along entire length of the exhaust tubing line.

## Blocked Flow Detection of Sample Line

Units equipped with the pump or air aspirator options are supplied with a flow detector. This flow detector activates the fault relay when insufficient flow exists for proper gas detection.

## Mounting the Air-line Toxgard II Monitor

### WARNING

**These units must not be located in areas which may contain a flammable mixture of gas and air; otherwise, an explosion may occur.**

### CAUTION

**Protect the Toxgard II Monitor from extreme vibration. Do not mount the sensing head in direct sunlight as this may cause the sensor to overheat.**

1. Using suitable hardware (not supplied) mount the Toxgard II monitor to any flat surface; allow room to open the door.
2. Connect the source of compressed air being monitored to the pressure regulator (fittings not included). Install the regulator as close as possible to the sample take-off.
  - The maximum regulator inlet pressure is 300 PSI.
  - The regulator outlet pressure should be set to a nominal 10 PSI.

NOTE: An in-line filter trap (P/N 626967 or equivalent) is recommended to prevent clogging of the flow system due to air line contamination, such as oil, dirt or moisture.

### CAUTION

**Do not exceed 300 pounds maximum inlet pressure; otherwise, damage to the unit may occur.**

3. Ensure the pressure regulator is fully counter-clockwise to reduce the initial pressure to the unit.

## Flow Block

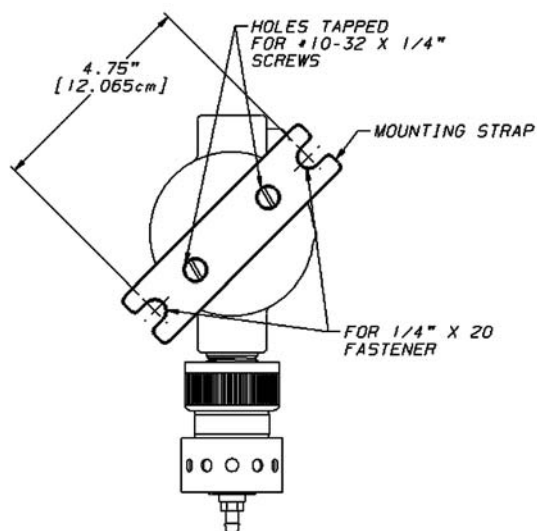
The Toxgard II Monitor equipped with the flow block option can be used to allow a sample to be delivered from a pressurized stream to the Toxgard II unit. Inlet pressure to the flow block should not exceed 10 PSI.

## Mounting the Toxgard II Remote Sensor Module

The Remote Sensor Module:

- is mounted where the gas is expected to exist
- is mounted with the sensor pointing downward via the 3/4" NPT threads located on the end of the module, opposite the sensor
- can also be mounted with the mounting strap (P/N 655700); see FIGURE 1-5
- wiring is routed to the Toxgard II Monitor.

Permanently connect 3/8" OD tubing to the center post of the sensor inlet. Route this tubing to the Toxgard II Monitor, ensuring there are no kinks, leaks or other obstructions. Secure this tubing near the monitor; it is used to deliver check gas to the sensor module during calibration.



*Figure 1-5. Remote Sensor Mounting Method*

## Electrical Connections for Toxgard II Monitors

- Recommended wire is three-conductor, 16 gauge (12 gauge maximum).
- Install an external switch or circuit breaker close to the unit for disconnection purposes.

- Install an over-current protection device (e.g., fuse) in the supply wiring to the unit; two-amp, slow acting fuses are recommended.

### **⚠ WARNING**

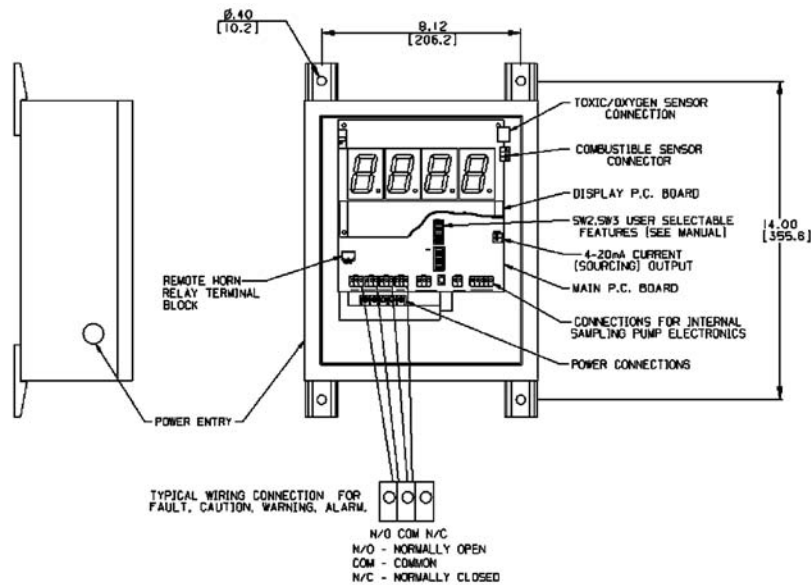
**Before wiring the Toxgard II Monitor, disconnect power source supplying the monitor; otherwise, electrical shock could occur.**

### **⚠ CAUTION**

**Make all wiring connections and conduit runs according to accepted commercial wiring practices. Install the Toxgard II unit in compliance with the applicable requirements of the National Electrical Code and/or any other local code requirements.**

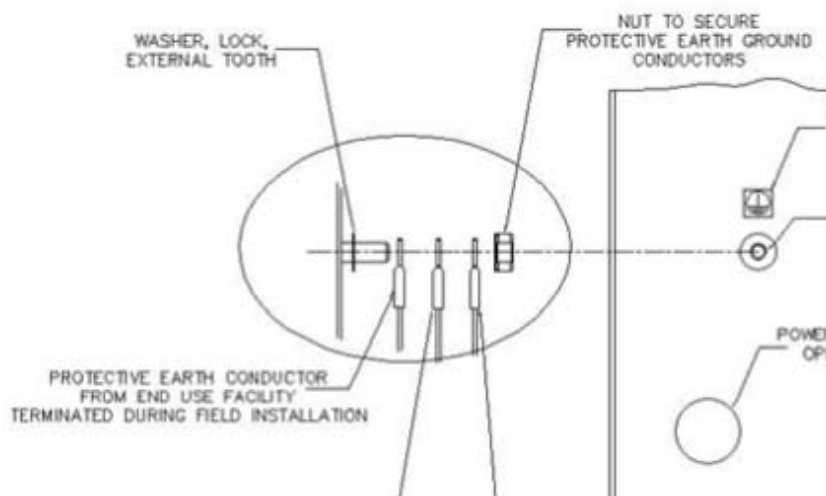
NOTE: For Toxgard II with Digital Output Monitors, see manual (P/N 711203) for wiring instructions.

- Route power, ground, and (where applicable) signal wiring through the electrical entry holes in the case (FIGURE 1-6).



**Figure 1-6. Toxgard II Cable Entries**

- The AC power wiring, consisting of Line, Neutral and Protective Earth will be provided by the end-user facility and routed through the Power Entry Opening. The Protective Earth conductor shall be applied first and secured independently to the enclosure's ground stud, nearest to Power Entry Opening, as shown in the image below. The conductor will be terminated with a ring terminal, which will accommodate a #10 stud and properly sized for gauge of conductor.



### ***Connection of Protective Earth Ground Conductors***

Recommended Wiring Supplied by the End Use Facility

Wire Gauge: #16 AWG, rated for 600 Volt

Color: Green/Yellow or Green, if part of AC power cordage

Temperature Range (C): -40 to +80

- Separate the power wiring from any signal wiring.
- The Toxgard II unit operates on an AC power source of 120 or 220 VAC (no selection switch is necessary).

### **⚠ CAUTION**

**If unsure of the power supply voltage available, contact your plant engineer or safety officer. Damage may occur to the instrument if the wrong power supply voltage is applied to the instrument.**

## Outputs

### Relays

#### Relay Specifications

**Table 1-2. Relay Specifications**

<b>RELAYS</b>	<b>3 ALARMS</b>	SPDT (Single pole, double throw)
	<b>FAULT (NORMALLY-ENERGIZED)</b>	SPDT (Single pole, double throw)
	<b>HORN RELAY</b>	SPST (Single pole, single throw), N/O
<b>RELAY RATINGS</b>	<b>At 125 or 250 VOLTS AC, NON-INDUCTIVE</b>	5.0 Amps
	<b>AT 30 VOLTS DC, NON-INDUCTIVE</b>	5.0 Amps
	<b>AT 1/10 HP</b>	5.0 Amps

#### Alarm Relays

There are three alarm relays, a fault relay and a horn relay in the Toxgard II Gas Monitor.

NOTE: Alarms are automatically disabled at the following times to avoid "nuisance" alarms:

- during first minute of power-up, while cell stabilizes
- during calibration and for two minutes following calibration.

#### Alarm Features

There are alarm levels in the Toxgard II unit, and a relay for each level. There are many user-selectable alarm features enabled or disabled by selecting or de-selecting them.

- Relays are standard electromechanical devices chosen for long life and high reliability.
- Relay contacts are brought out to the terminal block and used to control external lights, horns, and other equipment (FIGURE 1-6).
- Alarms generally default to 10, 20 and 30% of the full-scale reading and are set when the gas reading is above these values.
- The Oxygen Model is a special case where:
  - Caution is set to 19.5%, negative acting
  - Warning is set to 18% oxygen, negative acting

- Alarm is set to 22% oxygen, positive acting.
- These default setpoints are factory-set. The user can change these setpoints; see Chapter 1, "Changing Parameter Settings."
- Are available as N/O (normally-open) or N/C (normally-closed) contacts.
- For Normally-Open contacts:
  - Upon activation, the relay contacts close to provide an electrical path. These contacts remain closed as long as:
    - The alarm condition exists within the Monitor or
    - The latching mode is selected and the RESET button has not been pushed.
- For Normally-Closed contacts:
  - Upon activation, the relay contacts open to interrupt the electrical path. These contacts remain open as long as:
    - The alarm condition exists within the Toxgard II Gas Monitor or
    - The latching mode is selected and the RESET button has not been pushed.
- See Chapter 1, "Dip Switch Settings" to determine the dip switch settings for the other alarm options.

#### **Fault Relay**

- During normal operation, the Fault relay is energized.
- When a fault is detected or power is cut or turned OFF, the relay changes state. The form C contact can be wired as either normally-open (NO) or normally-closed (NC) for your needs.
- See the Chapter 5, TABLE 5-1, Troubleshooting Guidelines for causes of faults.

### **Horn Relay/Audible Outputs**

#### **Audible Outputs**

- The Toxgard II Monitor comes equipped with one of the following audible alarms:
  - Piezo Horn (standard) - 75 db at five feet
  - Federal Horn - 95 db at five feet (not adjustable)
  - Adjustable-Tone Banshee Horn - 95 db at five feet



(See Chapter 1, "Banshee Horn Audible Settings").

- The Audible Alarm sounds when the Toxgard II Monitor enters a Fault or Alarm State, if that option is enabled (see TABLE 1-5)
- These options are factory-set at time of purchase.

### **Horn Relay**

- This Single-pole, single-throw (SPST), normally-open (N/O) relay works in parallel with the instrument horn.
- These contacts are open when the instrument horn is OFF or not selected for operation [see FIGURE 1-6 for terminal block (TB9) location].
- The contacts:
  - close when the instrument horn activates
  - remain closed until the horn is de-activated due to:
    - elimination of the hazardous condition
    - pressing the HORN ACKNOWLEDGE button.

### **Relay Wiring with Inductive Loads**

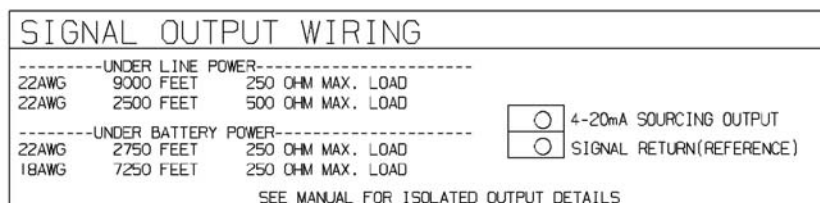
If you are connecting the relays to motors, fluorescent lighting or other inductive loads, it is necessary to suppress any sparks that may occur at the relay contact. These sparks will deteriorate or destroy the relay contacts, rendering the relay inoperative or useless. One way to reduce this destructive sparking is to install a Quencharc protector (MSA P/N 630413) across the contacts.

### **Milliamp Output**

The Toxgard II Monitor may be connected to any device capable of accepting 4 to 20 mA analog signals such as the:

- MSA Model 5000 Monitor
- MSA Quad Gas unit
- Programmable controllers
- DCSs, etc.

The standard unit is supplied with a non-isolated, 4-20 mA signal. An isolated 4-20 mA output option is also available.



**Figure 1-7. Standard 4-20 mA Terminal Wiring**

NOTE: The return path for this signal is connected to the Toxgard II Monitor "analog common" circuitry and, therefore, is not "isolated." The Toxgard II Monitor can be ordered from MSA with an optional current isolator module which fully isolates the instrument from supplementary instrumentation.

### Isolated 4-20 mA Output

- The Toxgard II current output [the (+) or upper terminal of TB1] connects to the isolator input (+) terminal
- The Toxgard II signal return [the (-) or lower terminal of TB1] connects to the isolator input (-) terminal.

#### For Signal Loads Less Than 50 Ohms:

- The user load connects to the isolator output (S) and (-) terminals.

#### For Signal Loads Greater Than or Equal to 50 Ohms:

- The user load connects to the isolator output (+) and (-) terminals.

#### Under Line-powered Conditions:

- The Toxgard II isolated current output can drive a maximum load of 310 ohms (including wire).

#### Under Battery-powered Conditions:

- The Toxgard II isolated current output is limited to a maximum load of 100 ohms.

### Digital Output

The Toxgard II Monitor can be used as part of a Ultima Plus high-speed digital network in order to report all internal parameters to a central

location. All that is additionally required if this option is selected, is a network communications board and a twisted-pair connection to the network. See Ultima Plus instructions for complete information concerning this option.

#### **⚠ WARNING**

**Since the Toxgard II Monitor is typically used as a safety instrument, it is recommended that the standard and optional outputs be used in the proper manner; otherwise, the user may not be notified of a condition that may not be considered normal.**

**Make wiring connections and conduit runs according to accepted commercial wiring practices. Install the Toxgard II unit in compliance with the applicable requirements of the National Electrical Code and/or any other local code requirements.**

## **Visual Outputs**

The unit comes equipped with the following visual alarms:

- front-panel LEDs for Fault, Caution and Warning (standard):
  - Latched Alarms cause the front-panel LED to flash
  - Unlatched Alarms cause the front-panel LED to turn ON.

Also, up to two top-mounted strobes can be added (optional):

- amber (follows Warning settings)
- red (follows Alarm settings)

Wiring for these options is factory-performed at time of purchase.

## **Horn/Alarm Acknowledge Button**

- A reset push-button is mounted on the enclosure exterior.
- An internally-mounted terminal strip allows the user to wire an external reset button.
- The reset button silences the audio horn and resets any latched relays or alarms with alarm setpoints no longer exceeded.
- The reset button silences the horn but not the beacon(s) when the alarms are latched and the gas concentration is still above the alarm setpoint.

If installing a RESET push-button:

1. Route a two-conductor cable to terminal block TB13.

- Route this cable with DC power to avoid noise interference from relay wiring.
2. Connect the two-conductor cable to the two positions of the N/O momentary switch.
  3. Identify the cable to enable proper connection at the button.
  4. Route the cable to the push-button location; wire the button.

## Remote Sensors

### Electrical Connections for the Remote Sensor Module

#### WARNING

**Before wiring the Toxgard II Remote Sensor Module, disconnect the power source feeding the Remote Sensor Module and the Toxgard II Monitor/Less Sensor; otherwise, electrical shock could occur.**

**Before removing the cover of an explosion-proof Toxgard II Remote Sensor Module, verify that the surrounding area does not contain a flammable mixture of combustible gas and air, since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.**

Toxgard II Remote Sensor Modules (excluding the combustible models) are supplied with 50 feet of cable. This cable has a connector on one end which plugs into its mate within the Toxgard II Monitor/Less Sensor. The other end of the cable can be cut to the exact length needed.

The combustible Remote Sensor Module is wired with a three-conductor cable. This cable can be acquired locally. Terminal strips within the Remote Sensor Module and the Toxgard II Monitor/Less Sensor permit easy wiring of this cable.

#### ⚠ CAUTION

**When installing a Toxgard II Remote Sensor Module with its mating Toxgard II Monitor/Less Sensor, follow National Electrical and local procedural Codes; failure to do so can result in an unsafe condition.**

Maximum distance between the Toxgard II Remote Sensor and the Monitor is 50 feet. Do not splice additional cable to the supplied cable or run more than 50 feet of user-supplied cable.

#### **For Combustible Models**

Locate/acquire the proper length of three-conductor cable. TABLE 1-3 shows recommended wire gauge for the distance between the Remote Sensor and the Toxgard II Monitor/Less Sensor.

**Table 1-3. Wire Gauge Vs. Distance Between Units**

<b>DISTANCE</b>	<b>WIRE GAUGE</b>
UP TO 15 FEET	16 AWG
UP TO 25 FEET	14 AWG
UP TO 50 FEET	12 AWG

TABLE 1-4 lists several suppliers of 12-AWG cable. If there is a possibility of electrical interference from external sources (such as large motors, welders, electrical heaters, etc.) use shielded cable.

The preferred colors of conductors within the cable are black (K), green (G) and white (W). If splices are necessary, solder and insulate each conductor; then, wrap entire splice with suitable electrical tape or covering. Do not use wire nuts or fasteners.

**Table 1-4. Remote Combustible Sensor Wiring Cable**

<b>THE FOLLOWING CABLES ARE THREE-CONDUCTOR, 12-AWG SHIELDED, .625" OD</b>	
<b>CABLE SUPPLIERS</b>	<b>CATALOG NUMBER</b>
CAROL CABLE CO.	02725
ALPHA WIRE CORP.	1937/3
BELDEN WIRE & CABLE CO.	19206

Appropriate wiring conduit must be used between the Toxgard II Monitor and the Toxgard II Remote Sensor. The cable must be routed through conduit.

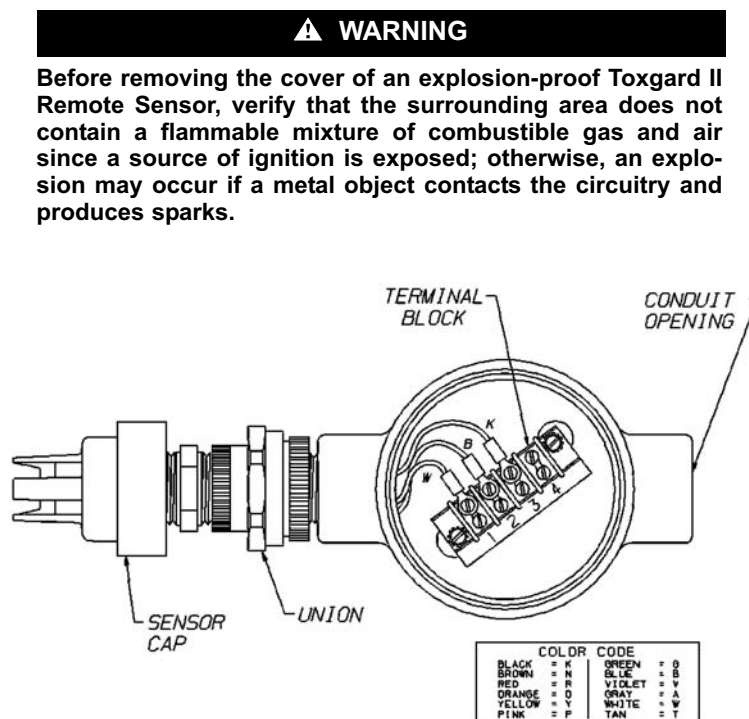
#### **Wiring the Toxgard II Monitor/Less Sensor Using the Internal Terminal Block**

1. Open the unit.

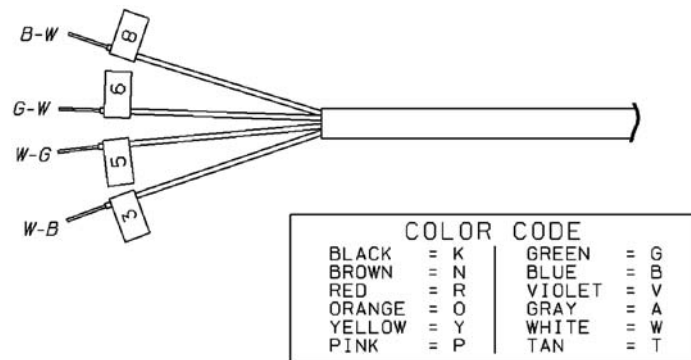
2. Locate TB2 in the upper-right portion of the main (lower) pc board.
3. Install wires onto positions 1, 2 and 3, noting the color used on each position.

**At the Toxgard II Remote Sensor Location  
(FIGURES 1-8, 1-9 and 1-10)**

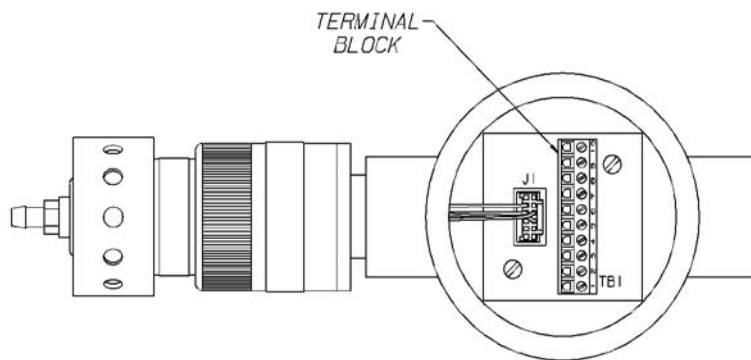
1. Unscrew and open the Toxgard II Remote Sensor cover.



**Figure 1-8. Combustible Remote Sensor**



**Figure 1-9. Oxygen Remote Sensor Cable**



**Figure 1-10. Oxygen and Toxic Remote Sensor**

2. Route the cable from the Toxgard II Monitor through the conduit opening and wire it to the terminal block in the bottom of the sensor.

NOTE: Separate the power and ground wiring from any signal wiring.

3. Verify the identity of each conductor of the cable and connect the wire to the terminal block so that position 1 in the sensor is wired to position 1 on the Toxgard II Monitor TB2. Similarly, sensor positions 2 and 3 connect to Toxgard II positions 2 and 3.

If shielded wire is used:

- Cut the shield wire short.
  - Do not connect the shield at the remote sensor.
4. Screw the conduit into the conduit opening and relieve any excess slack in the cable.
  5. Re-install the cover of the Toxgard II Remote Sensor.

#### **⚠ WARNING**

**Do not allow the cover to remain off of an explosion-proof Toxgard II Sensor. since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.**

### **Oxygen Remote Sensor Wiring**

Fifty feet of four-conductor cable is supplied with the unit. This cable has a connector on one end which plugs into its mate within the Toxgard II Monitor/Less Sensor; the other end of the cable can be cut to the exact length needed. Do not run more than 50 feet of cable or splice on any additional cable.

### **At the Toxgard II Monitor/Less Sensor Location**

The cable connects to J5 at the upper right portion of the (lower) main pc board.

### **At the Toxgard II Remote Oxygen Sensor Location**

1. Unscrew and open the Toxgard II Remote Sensor cover.

#### **⚠ WARNING**

**Before removing the cover of an explosion-proof Toxgard II Remote Sensor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.**

2. Route Toxgard II Monitor cable through the conduit opening and wire it to the terminal block in sensor bottom.
3. Verify the identity of each conductor cable and connect the wire to the terminal block (FIGURE 1-10).

Note that there are four wires needed out of the six within the cable. Use the markings on the conductors at the end of the original cable or see FIGURE 1-10 for the colors of the wires that are needed.



CONDUCTOR ID	TERMINAL BLOCK LOCATION
WHITE WITH BLUE	3
WHITE WITH GREEN	5
GREEN WITH WHITE	6
BLUE WITH WHITE	8

- The other wire within the cable is not used.
  - It is unnecessary to connect wire to the other terminal positions within the remote sensor.
  - Do not connect the shield at the remote sensor.
4. Screw the conduit or cable grip or gland into the conduit opening. Relieve any excess slack in the cable.
  5. Re-install the cover on the Toxgard II Remote Sensor.

**⚠ WARNING**

**Do not let the cover remain off of an explosion-proof Toxgard II Sensor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.**

## Toxic Gas Remote Sensor Wiring

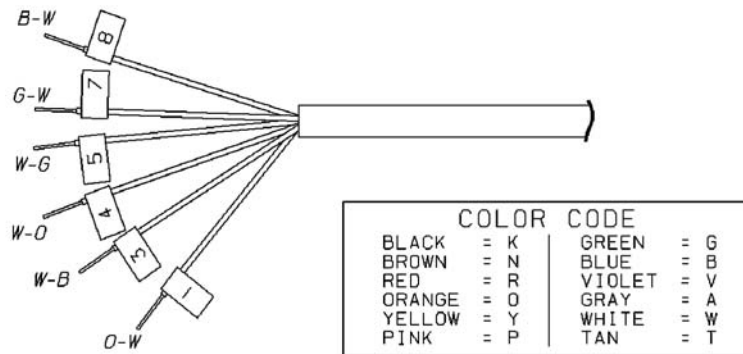
(FIGURE 1-12)

Fifty feet of six-conductor cable is supplied with the unit.

- This cable has a connector on one end which plugs into its mate within the Toxgard II Monitor/Less Sensor.
- The other end of the cable can be cut to the exact length needed.
- Do not run more than 50 feet of cable or splice on additional cable.

### At the Toxgard II Monitor/Less Sensor Location

The cable connects to J5 at the upper right portion of the (lower) main pc board.



**Figure 1-11. Toxic Gas Remote Sensor Cable**

#### **At the Toxgard II Remote Toxic Sensor Location**

1. Open the Toxgard II Remote Sensor cover by unscrewing it.

#### **⚠ WARNING**

**Before removing the cover of an explosion-proof Toxgard II Remote Sensor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.**

2. Route the cable from the Toxgard II Monitor through the conduit opening and wire it to the terminal block in the bottom of the sensor.
3. Verify the identity of each conductor cable and connect the wire to the terminal block (FIGURE 1-11).

CONDUCTOR ID	TERMINAL BLOCK LOCATION
ORANGE WITH WHITE	1
WHITE WITH BLUE	3
WHITE WITH ORANGE	4
WHITE WITH GREEN	5
GREEN WITH WHITE	7
BLUE WITH WHITE	8

- There are no connections to positions 2 and 6 of the terminal block within the remote sensor.
  - Do not connect the shield at the remote sensor.
4. Screw the conduit or cable grip or gland into the conduit opening; relieve any excess slack in the cable.
  5. Re-install the Toxgard II Remote Sensor cover.

#### **WARNING**

**Do not allow the cover to remain off of an explosion-proof Toxgard II Sensor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.**

## Pump Wiring

(FIGURE 1-13)

## Dip Switch Settings

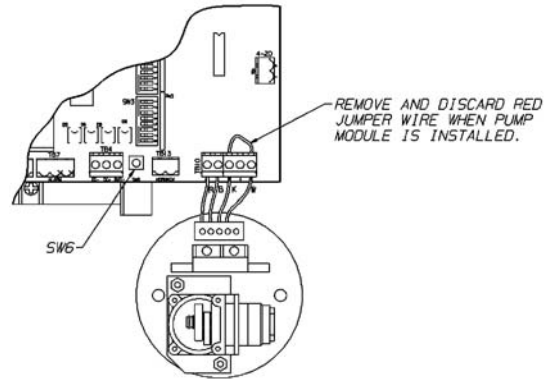
Many of the Toxgard II features can be set with the SW2 and SW3 Dip Switches located on the main monitor printed circuit board (FIGURE 1-1). TABLES 1-5 and 1-6 show the positions for user-selectable settings (FIGURE 1-5):

**Table 1-5. SW2 Switch Settings**

NOTE: **LEFT** side of each SW2 Dip Switch indicates the **ON** position and **RIGHT** side of each SW2 Dip Switch indicates the **OFF** position.

NUMBER	FUNCTION
1	SPARE
2	FAULT ACTIVATES HORN
3*	CAUTION ACTIVATES HORN
4*	WARNING ACTIVATES HORN
5*	ALARM ACTIVATES HORN
6	CAUTION POSITIVE/NEGATIVE ACTION (OFF = POSITIVE)
7	WARNING POSITIVE/NEGATIVE ACTION (OFF = POSITIVE)
8	ALARM POSITIVE/NEGATIVE ACTION (OFF = POSITIVE)

**\*NO AUDIBLE ALARM WILL SOUND IF SWITCHES 3, 4 AND 5 ARE ALL OFF.**



**Figure 1-12. Pump Wiring**

**Table 1-6. SW3 Switch Settings**

NOTE: LEFT side of each SW3 Dip Switch indicates the ON position and RIGHT side of each SW3 Dip Switch indicates the OFF position.

NUMBER	FUNCTION
1	SPARE (LEAVE IN OFF POSITION)
2	SPARE
3	OFF DELAY ON/OFF - CAUTION
4	OFF DELAY ON/OFF - WARNING
5	OFF DELAY ON/OFF - ALARM
6	*OFF DELAY TIME - BIT2
7	*OFF DELAY TIME - BIT1
8	*OFF DELAY TIME - BIT0

NOTE: The delay time selected via switches 6 - 8 will apply to any delay switch(es) 3 - 5 in the ON position.

*OFF DELAY TIME			
BIT2	BIT1	BIT0	TIME (IN SECONDS)
OFF	OFF	OFF	5
OFF	OFF	ON	15
OFF	ON	OFF	30
OFF	ON	ON	60
ON	OFF	OFF	90
ON	OFF	ON	120
ON	ON	OFF	150
ON	ON	ON	180

## Controller/Calibrator Operation

The Toxgard II Monitor is fully compatible with the Ultima Controller and the Ultima Calibrator. These devices can be used to set various parameters in the Toxgard II Monitor, including alarm conditions, auto calibration configuration, etc.

The devices can also be used for calibrating the Toxgard II Monitor. When using these devices, point them at the front panel of the Toxgard II Monitor, aiming directly at the triangular IR symbol (located next to the word "WARNING" at the center of the front panel). For full Calibrator and Controller operational details, refer to instruction manual (P/N 813379).

## Internal Push-buttons

A pair of internal push-buttons on the Toxgard II main pc board, lower-right corner (FIGURE 1-1) can be used in place of the Ultima Controller and Calibrator for most functions.

The right-hand button marked "CAL" is used to initiate all instrument calibration functions, eliminating the need to use the Controller or Calibrator to perform calibration.

The left-hand button marked "MODE" allows the user to scroll and view the Toxgard II configuration parameters. This operation is comparable with the Controller "send display item" feature.

## Viewing Configuration Parameters

At initial installation, use the Toxgard II MODE push-button (FIGURE 1-1) to review the Toxgard II configuration parameters.

To scroll, press and release the MODE push-button. The Toxgard II Monitor:

- temporarily stops displaying gas measurement readings
- displays a value and other relevant information for a parameter (TABLE 1-7).

NOTE: Pressing and releasing the MODE push-button within 10 seconds enables the user to scroll to the next parameter. If the user does not press the push-button within 10 seconds, the Toxgard II Monitor ends the parameter viewing mode and returns to a display of the actual gas measurement.

The Toxgard II Monitor is able to detect and notify the user of a hazardous condition even while scrolling the parameters. Although the LED continues scrolling, the hazardous condition is noted by the horn, relays and strobes (if equipped). When the scroll list ends, the LED display will show the alarm condition and gas measurement value.

**Table 1-7. Parameters Displayed During MODE Push-button Operation**

TEXT MESSAGE	DESCRIPTION
MIN VALUE	Minimum gas concentration of the previous time interval
MAX VALUE	Maximum gas concentration of the previous time interval
AVG VALUE	Average gas concentration of the previous time interval
ZERO VALUE	Gas concentration expected to be applied at the next calibration
SPAN VALUE	Gas concentration expected to be applied at the next calibration
LEVEL #1 (CAUTION)	Setpoint, enabled/disabled, latched/unlatched information
LEVEL #2 (WARNING)	Setpoint, enabled/disabled, latched/unlatched information
LEVEL #3 (ALARM)	Setpoint, enabled/disabled, latched/unlatched information
CURRENT TIME	Current time, in a 24-hour format
FUTURE CAL TIME	Time that an Autocal calibration will be performed (applicable only for operation with an Autocal unit)
AVG INTERVAL	Time interval (in hours) used to determine minimum, average and maximum gas concentration values
CURRENT DATE	Display toggles between current day of month and year
FUTURE CAL DATE	Date that the next Autocal calibration will be performed. Display toggles between day of month and year (applicable only for operation with an Autocal unit)
PREVIOUS CAL DATE	Date of the previous calibration
MUX ADDRESS	Instrument address when used on a Ultima Plus Network
CALIBRATION INTERVAL	Days between Autocal calibrations (for Autocal operation only)
CAL SIGNAL STATUS	ON/OFF status of the 3.75-mA signal during calibration
TEMPERATURE	Toxic sensor temperature
VALUE	MSA diagnostic; please ignore
VALUE	MSA diagnostic; please ignore
VALUE	MSA diagnostic; please ignore

## Changing Parameter Settings

### Method 1 - Push-buttons

The following parameters can be set by using the MODE and CAL push-buttons (located on the Toxgard II Monitor main printed circuit board):

ALARM 1	ON/OFF	LATCH/UNLATCH	VALUE
ALARM 2	ON/OFF	LATCH/UNLATCH	VALUE
ALARM 3	ON/OFF	LATCH/UNLATCH	VALUE
SPAN GAS			VALUE
CALIBRATION SIGNAL	ON/OFF		
AVERAGE TERM VALUE			VALUE

### General

#### To enter the Parameter Setting Mode:

1. Press and hold the MODE button.
2. While holding the MODE button, press the CAL button; then, release both buttons.

#### Once in the Parameter Setting Mode:

1. Use the MODE button to change the displayed value.
2. Use the CAL button to accept and save the displayed setting.

#### Once a single parameter is set:

- the display advances to the next parameter.

#### When changing an alarm value or span value:

- each press of the MODE button increases the value
- the step value of that increment is determined by the full-scale range
- if an entry error is made:
  1. Press the CAL button repeatedly until "END" displays.
  2. Restart parameter setting mode and enter correct data.

NOTE: During the Parameter Setting Mode, normal unit operation is suspended until this mode is exited. No network communications, peripheral communications, or alarm updates occur in this mode. The current signal output will be equivalent to a CAL signal of 3.75 mA.

When "END" displays, the Parameter Setting Mode is complete and normal operation resumes.

- If no key is pressed during the Parameter Setting Mode:
  - the unit returns to normal operation in one minute
  - any values that were accepted by using the CAL button are saved.

**When the unit returns to normal operation:**

Use the MODE button to display and verify the settings.

**Alarm Setting:**

- if the alarm is set to OFF (disabled):
  - latching status and value are not shown
- once the upper limit is reached, the value rolls over to the minimum value
- for toxic and oxygen units:
  - the upper limit is the full-scale reading
- for combustible units:
  - the upper limit is 60% LEL.

**Method 2 - Ultima Controller**

Parameters, alarm levels and their latched/unlatched modes of operation are set and changed using an Ultima Controller (P/N 809086). Refer to the Ultima Controller Instruction Manual (P/N 813379) for full instructions.

**Battery Backup**

The Toxgard II Monitor can be configured with an (internal) rechargeable backup battery that permits full instrument operation if main power is interrupted or the Toxgard II Monitor is used as a transportable instrument for temporary gas monitoring of an area; the carrying handle and side-mount sensor are convenient options if the



Toxgard II Monitor is used as a transportable gas monitor.

This battery is:

- a 12-volt, sealed lead acid type with a nominal power rating of 2.2 amp-hours
- continuously charged by the Toxgard II Monitor during normal operation.

Transfer to the backup battery is automatic when main power loss occurs. While operating on the backup battery, "BATT" lights on the Toxgard II display. When main power is restored, the "BATT" turns OFF, and the battery will start to recharge.

The amount of time that the backup battery can operate the Toxgard II Monitor depends on the:

- type of sensor
- installed options
- presence of alarm conditions
- ambient conditions.

TABLE 1-7 can be used as an approximation of expected battery operating time. In this table:

- "Minimum Time" represents a Toxgard II Monitor configured with:
  - strobes flashing
  - alarm conditions asserted
  - Federal horn operational
  - internal pump
- "Maximum Time" represents a Toxgard II Monitor configured with:
  - no strobes
  - no alarms
  - no horn
  - no pump.
- Actual battery lifetime falls somewhere between the indicated Minimum Time and Maximum Time values.

**Table 1-8. Expected Battery Operating Time at 77° F**

SENSOR TYPE	MINIMUM TIME	MAXIMUM TIME
Combustible	1 hour	10 hours
Toxic or oxygen	0.5 hours	24 hours

NOTE: As ambient temperature drops, the expected battery operating time period decreases. At -4°F (-20°C), the times shown in TABLE 1-8 are reduced to 60%.

During battery operation, the Toxgard II unit monitors backup battery voltage. When voltage is reduced to a level where continued operation yields unreliable instrument operation and possible battery damage the instrument LED displays **Err6** for 3 seconds and then turns itself OFF until main operating power is restored.

**⚠ WARNING**

**The "Fault" relay must be connected to an alarming device to alert the user the instrument is no longer operational when the above condition occurs.**

NOTE: The Toxgard II battery pack requires up to 24-30 hours of uninterrupted main power to fully charge.

NOTE: Normally, the unit automatically transfers power to the optional backup battery when the main power is lost. However, if the user wants to start the unit from an unpowered state using the battery, press SW6 on the main printed circuit board (FIGURE 1-13).

## **Banshee Horn Audible Settings**

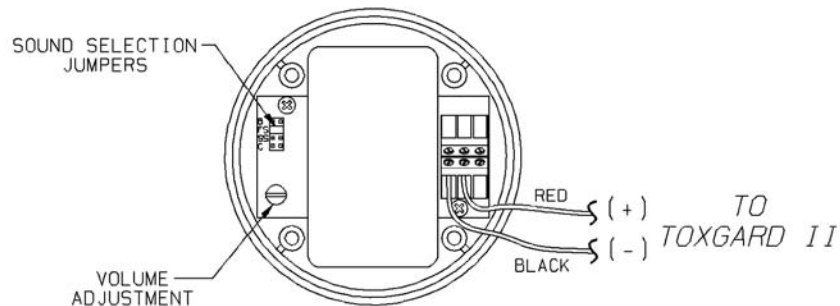
The Banshee Horn can produce several distinctly different sounds. These sounds and the volume of these sounds can be adjusted as follows:

1. Disconnect the main operating power from the Toxgard II Monitor.
2. If the Toxgard II Monitor is equipped with an internal back-up battery, carefully disconnect the WHITE wire from the battery (+) terminal.

NOTE: Record the position of the RED and BLACK wires connecting the horn to TB12 on the Toxgard II Monitor main pc board. When this procedure is complete, return these wires to their original positions.

3. Remove the four screws from the face of the horn.
4. Carefully separate the body halves of the horn.
5. To change the sound of the Banshee Horn, move the push-on jumper to the position to provide the desired sound (FIGURE 1-14).

NOTE: The internal horn label shows which sound corresponds with each position.



**Figure 1-13. Banshee Horn Audible Settings**

6. To change the volume of the Banshee Horn, use a small, flat screwdriver to adjust the volume control shown on FIGURE 1-14.
- NOTE: The loudest volume is obtained in the fully clockwise position.
7. When settings are complete, verify that the internal rubber gasket lines up with the screw holes.
  8. Carefully mate the two halves of the horn and place the excess slack of the RED and BLACK wires inside the T.
  9. Replace the four screws and tighten to ensure a weatherproof seal.
  10. Move the RED and BLACK wires connecting the horn and the Toxgard II Monitor main pc board into their original positions.
  11. Reconnect the main operating power, and reconnect the WHITE wire to the Toxgard II Monitor internal backup battery (if so equipped).

**⚠ WARNING**

**Verify the proper operation, sound and loudness of the Banshee Horn; otherwise, the horn cannot properly alert the user.**

## **Autocalibration Option**

The Toxgard II Monitor is available with an autocalibration option. This user-selectable option allows periodic, unmanned gas calibration of the system.

- This option is not available for units with sampling options, nor is it available for monitoring of the following target gases:
  - chlorine
  - chlorine dioxide
  - hydrogen chloride
  - nitrogen dioxide.

For installation details, refer to the autocalibration Instruction Manual (P/N 815379).

## **Duct-Mounted Remote Sensor Installation**

Refer to Appendix A for this option.

## Chapter 2, Start-up

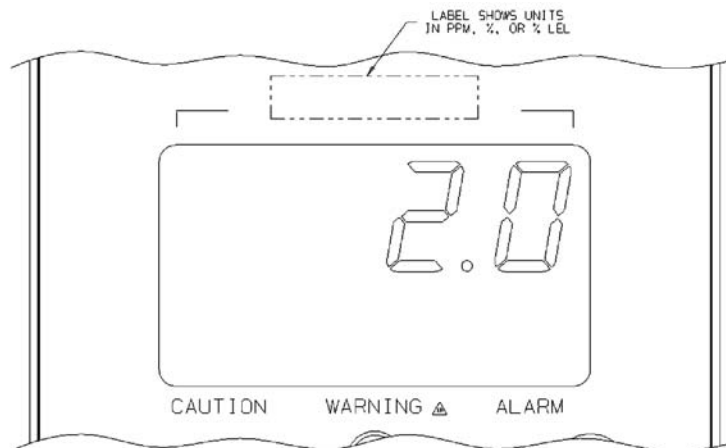
### Initial Start-up

The Toxgard II Monitor is factory-calibrated and ready for immediate use. Its range and output are preset. Once power is applied to the unit, the display shows a test of all display words and segments. The software version number displays; then, a 25-second warm-up countdown for sensor stability begins:

- a blank screen appears between each second of countdown time.
- There is no signal output during this warm-up time.

The Monitor shows the software version number again; then, it begins to display the gas concentration in the corresponding unit of measurement (FIGURE 2-1):

- ppm (for toxic gases)
- % Gas (for oxygen only)
- % LEL (for combustible gases).



**Figure 2-1. Gas Concentration Display**

After initial start-up, the Toxgard II Monitor also displays a calibration flag as a reminder to perform a field calibration (FIGURE 2-2). While this message is displayed, the Toxgard II Monitor is functioning within factory-set calibration parameters. Once the first successful field calibration is performed, the calibration flag turns OFF.

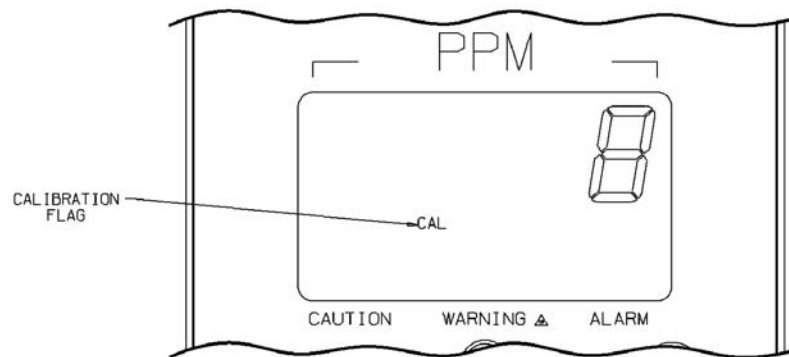
**⚠ CAUTION**

**To ensure a fully functional sensor, perform a calibration check and adjustments at initial start-up.**

During normal operation, the Toxgard II Monitor displays the gas concentration of the surrounding environment. The corresponding output signal can be transmitted to a controller. For a complete listing of display and output conditions other than normal operation, see TABLE 5-1.

NOTE: The combustible gas model of the Toxgard II Monitor is capable of detecting concentrations of certain combustible gases above 100% LEL. When exposed to these concentrations, the Toxgard II Monitor will display one of two modes:

- **LOC % LEL** - The Toxgard II Monitor has been exposed to a high concentration of gas (above the LEL) and there is a possibility that the over-range condition may still exist.
- **100 % LEL** - The Toxgard II Monitor has been exposed to a high concentration of gas (above the LEL) and the over-range condition definitely still exists.



**Figure 2-2. Calibration Flag Display**

### **⚠ CAUTION**

**In either mode, correct the condition causing the excessive gas level and vent or purge the area before attempting the following.**

In the LOC % LEL mode, the output signal is also locked at full-scale. If this condition occurs, the Toxgard II Monitor must be unlocked by performing a "Zero Function," either with the Ultima® Calibrator or Controller or by using the internal "CAL" push-button.

NOTE: The Ultima Calibrator and Controller are compatible with both the Ultima Gas Monitor and the Toxgard II monitor.

In the LOC mode, The Toxgard II Monitor will not revert to a normal condition until a successful zero operation has been performed. This is an exclusive safety feature of the Toxgard II Monitor which pre-empts the possibility of ambiguous readings when the sensor is exposed to concentration of gas above 100% LEL.

In the 100% LEL mode, the combustible gas is over the 100% LEL range. It will return to normal operation when the gas concentration level falls below 100% LEL.

## **Calibration**

As with any type of gas monitor, the only true check of its performance is to apply gas directly to the sensor. The frequency of the calibration gas tests depends on the operating time and chemical exposures of the sensors. New sensors should be calibrated more often until the calibration records prove sensor stability. The calibration frequency can then be reduced to the schedule set by the safety officer or plant manager. Before calibrating the sensors, it is good practice to apply power to the unit to allow the sensor to adapt to the new environment. This is especially important for the following units:

- chlorine
- nitric oxide
- hydrogen cyanide
- hydrogen chloride
- chlorine dioxide.

Sensors should be powered at least one half hour before any calibration attempt is made.

Combustible sensors located in areas where non-combustible chemicals may leak, particularly ones known to reduce the sensitivity (see following list) should be calibrated after such exposures.

#### Non-combustible Chemicals that Reduce Sensor Sensitivity

- Silanes, Silicates, Silicones and Halides (compounds containing Fluorine, Chlorine, Iodine or Bromine)
- TABLE 2-1 lists interferants for electrochemical sensors.

**Table 2-1. Sensor Response to Interferants**

<i>(ND = No Data)</i>										
INTER-FERANT	CONCENTRATION (PPM)	CO	H <sub>2</sub> S	SO <sub>2</sub>	HCN	NO <sub>2</sub>	Cl <sub>2</sub>	HCL	NO	ClO <sub>2</sub>
Acetone	1000	0	0	0	0	0	ND	ND	ND	ND
Acetylene	12000	ND	0	ND	ND	0	ND	ND	ND	ND
Ammonia	100	0	0	ND	0	0	0	ND	ND	0
Benzene	20	0	0	0	0	0	0	ND	ND	0
Carbon Dioxide	5000	0	0	0	2.5	0	0	ND	ND	0
Carbon Disulfide	15	2	0	ND	0.1	ND	0	ND	ND	0
Carbon Monoxide	100	100	7	0.2	1	0	0	3 -	3	0
Chlorine	5	0	0	-6	-0.2	4	5	-1	0	2.5
Dimethyl Sulfide	5	2	0.4	3	-0.2	0	0	ND	ND	0
Ethanol	100	115	0	0	0	0	ND	ND	ND	ND
Ethylene	50	99	0.1	0	-0.3	0	0	ND	ND	0
Ethyl Ether	400	3	ND	ND	ND	0	ND	ND	ND	ND
Freon 12	1000	-2	0	ND	2	0	0	ND	ND	0
Freon 113	1000	1	0	ND	2.4	ND	ND	ND	ND	ND
Freon 12BI	1000	0	0	ND	ND	ND	ND	ND	ND	ND
Freon 13BI	1000	0	0	ND	ND	ND	ND	ND	ND	ND
Hexane	500	0	0	0	0	0	0	ND	ND	0
Hydrogen	500	28	0.5	15	0	-15	0	ND	ND	0
Hydrogen Chloride	100	0	0	ND	ND	0	ND	100	4	ND

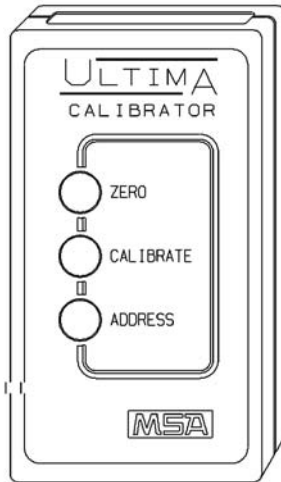


<b>(ND = No Data)</b>										
<b>INTER-FERANT</b>	<b>CONCENTRATION (PPM)</b>	<b>CO</b>	<b>H<sub>2</sub>S</b>	<b>SO<sub>2</sub></b>	<b>HCN</b>	<b>NO<sub>2</sub></b>	<b>Cl<sub>2</sub></b>	<b>HCL</b>	<b>NO</b>	<b>ClO<sub>2</sub></b>
Hydrogen Cyanide	10	5	0	3	10	0	0	2.5	0	0
Hydrogen Sulfide	10	0	10	0	50	-8	-0.5	4.5	4	-0.25
Isopropanol	50	40	0	0	0	0	0	ND	ND	0
Mercaptan (Ethyl)	5	7	2.7	ND	6.5	ND	0	ND	ND	0
Mercaptan (Methyl)	5	7	4.5	ND	6	ND	ND	ND	ND	ND
Methane	50000	0	0	0	1	0	0	ND	ND	0
Methanol	50	130	0	0	0.1	0	0	ND	ND	0
Methyl Amine	100	0	ND	ND	ND	0	ND	ND	ND	ND
Methyl Bromide	500	0	ND	0	ND	0	ND	ND	ND	ND
Methyl Ethyl Ketone	200	0	ND	0	ND	0	ND	ND	ND	ND
Nitric Oxide	100	10	2.2	2	-3	3	2	0	100	1
Nitrogen Dioxide	10	-2	-8.4	-10	-20	10	12	-1	2	6
Sulfur Dioxide	150	1	4.7	NA	400	0	0	35	7.5	0
Tichloro-ethylene	1000	0	ND	0	ND	ND	ND	ND	ND	ND

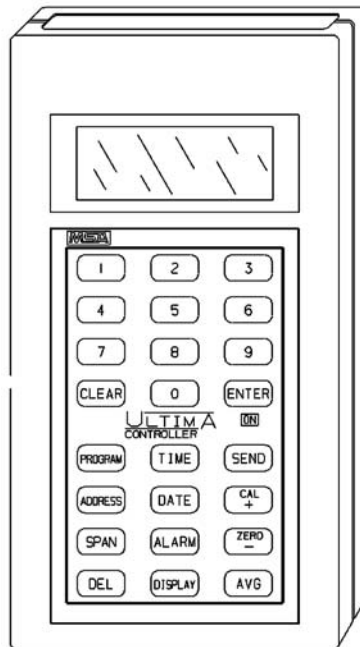
When it is determined that calibration adjustments are required, the Toxgard II Monitor provides a one-man, non-intrusive method of adjustment at the unit.

To calibrate the unit, the internal push-buttons or one of the following accessories can be used:

- Calibrator P/N 809997 (FIGURE 2-3)
- Controller P/N 809086 (FIGURE 2-4).



**Figure 2-3. Ultima Calibrator**



**Figure 2-4. Ultima Controller**

### **Calibrator**

The Calibrator allows the following functions:

- Zero
- Calibration (zero and span)
- Display address for digital output models.

### **Toxgard II Monitor Controller**

The Controller also provides the above functions and access to the additional following features:

- Automatic calibration at timed intervals when used with MSA autocalibration module.

NOTE: If the autocalibration module was purchased for use with the Toxgard II Monitor, consult the MSA Ultima Controller Instruction Manual (P/N 813379) for set-up and operation.

- Three levels of alarm
- Date of last successful calibration
- Maximum and minimum gas readings over selected time periods
- Average gas readings over selected time periods
- Changing of span gas value from factory-set value
- Access to real-time clock for a time and date stamp

See Calibrator and Controller instruction manual (P/N 813379) for proper calibration procedures.

### **Toxgard II Monitor Calibration Output Signal**

The Toxgard II Monitor is shipped with the calibration output signal disabled so the output signal will track the gas concentration value during the calibration process. In some applications, it may be desirable to disable or lock the output during calibration to a pre-determined output value to prevent activation of alarm devices. The calibration signal can be enabled using the Controller. When the calibration signal is enabled, the output signal is 3.75 milliamps during calibration.

NOTE: The Controller is compatible with both the Ultima Gas Monitor and the Toxgard II Monitor.

## Chapter 3, Calibration

The Toxgard II Gas Monitor provides non-intrusive calibration through the use of the Calibrator or Controller. The unit can also be calibrated using the internally-mounted "CAL" push-button.

NOTE: The Calibrator and Controller are compatible with both the Ultima Gas Monitor and the Toxgard II monitor.

When calibrating any Toxgard II Gas Monitor, refer to the Calibration Kit instructions.

When first placing the Toxgard II Gas Monitor into operation it is good practice to perform a calibration. When replacing the sensor, it is necessary to do an initial calibration which allows the unit to store the initial sensor parameters for proper end-of-life indication. Refer to Chapter 3, "Initial Calibration."

Read the appropriate calibration instructions before attempting an actual calibration. Also, identify and become familiar with all of the calibration components. During the calibration, it is necessary to quickly apply the span gas to the unit. Prior connection of the calibration components will aid in the ease of unit calibration.

### Equipment Required

Three calibration kits (numbered 40, 41, and 54) are available from MSA for diffusion calibration of Toxgard II Gas Monitors. Kit 40 is also used to calibrate the Toxgard II Air Line Monitor. Calibration Kits 42 and 43 are used to calibrate Toxgard II monitors with pumped samples. All Calibration Kits are housed in a convenient carrying case and contain all items necessary (less gas) for a complete and accurate calibration.

The check or calibration gases can also be carried in the case. See TABLE 3-1 for the appropriate zero and span gas cylinders for your Toxgard II Gas Monitor.

#### **WARNING**

**These calibration kits contain zero caps in place of zero calibration gas. These caps can only be used when the ambient air does not contain the gas the monitor is detecting. If there is any doubt, use zero gas when zeroing the Toxgard II Monitor; otherwise, improper calibration could occur.**

**Table 3-1. Factory-set Span Values**

<b>GAS TYPE</b>	<b>RANGE</b>	<b>SPAN GAS PRESET VALUES</b>	<b>MSA RP CYLINDER P/N</b>	<b>CALIBRATION KIT</b>
CARBON MONOXIDE	0-100 PPM	60 PPM	710882	40
	0-500 PPM	300 PPM	10027938	40
SULFUR DIOXIDE	0-25 PPM	10 PPM	10028070	40
HYDROGEN SULFIDE	0-10 PPM	5 PPM	710414	40
	0-50 PPM	40 PPM	10028062	40
	0-100 PPM	40 PPM	10028062	40
NITRIC OXIDE	0-100 PPM	50 PPM	10028074	40
NITROGEN DIOXIDE	0-10 PPM	5 PPM	710332	41
CHLORINE	0-5 PPM	2 PPM	710331	41
HYDROGEN CYANIDE	0-50 PPM	10 PPM	10028072	41
HYDROGEN CHLORIDE	0-100 PPM	40 PPM	10028078	54
CHLORINE DIOXIDE <sup>(4)</sup>	0-3 PPM	1 PPM	710331	41
OXYGEN	0-25%	20.8%	10028028 <sup>(2)</sup>	40
NATURAL GAS <sup>(3)</sup>	0-100% LEL	25% LEL <sup>(1)</sup>	10028034	40
PETROLEUM VAPORS <sup>(3)</sup> (GASOLINE)	0-100% LEL	40% LEL <sup>(1)</sup>	10028034	40
GENERAL SOLVENTS <sup>(3)</sup>	0-100% LEL	55% LEL <sup>(1)</sup>	10028034	40

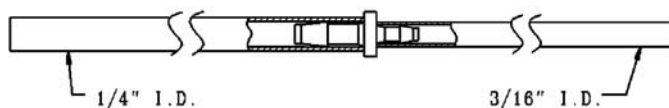
**NOTES:**

- 1 Calibrated with Propane (.6% gas by volume)
- 2 Not required for standard calibration procedure
- 3 For combustible gas, it is good practice to calibrate unit with the gas to be detected
- 4 ClO<sub>2</sub> is calibrated with Cl<sub>2</sub>
- 5 Change span gas value with Controller to use low range calibration cylinder.

## Calibration Kits 40 and 42

Calibration Kit 40 will calibrate all diffusion Toxgard II Gas Monitors and Calibration Kit 42 will calibrate all sample draw Toxgard II Gas Monitors for the following gases (FIGURE 3-1):

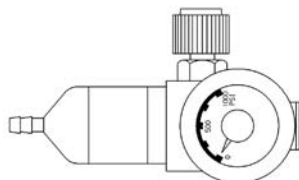
- Carbon Monoxide
- Oxygen
- Hydrogen Sulfide
- Sulfur Dioxide
- Nitric Oxide
- All Combustible gases.



*Item 1 - Tubing (P/N 711112)*  
- 3/16" ID side connects to Item 3  
- 1/4" ID side connects to sensor



*Item 2 - Zero Cap  
(P/N 710535)*



*Item 3 - 1.5 LPM Flow  
Controller (P/N 478358)*

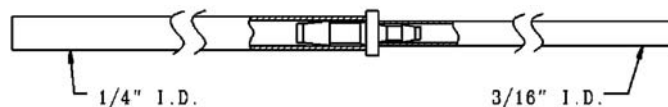
**Figure 3-1. Calibration Kit 40 Contents**  
**(Your Kit may also include one or two gas cylinders)**

## Calibration Kits 41 and 43

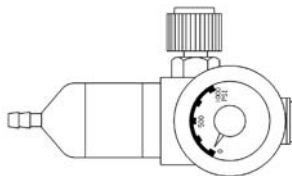
Calibration Kit 41 will calibrate all diffusion Toxgard II Gas Monitors and Calibration Kit 43 will calibrate all sample draw Toxgard II Gas Monitors for the following gases (FIGURE 3-2):

- Chlorine
- Nitrogen Dioxide
- Chlorine Dioxide
- Hydrogen Cyanide.

NOTE: The calibration procedure for the sample draw Toxgard II Monitor is the same as the procedure for the diffusion version, except calibration gas is applied to the calibration



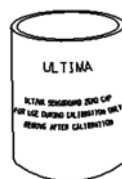
*Item 1 - Tubing (P/N 711112)*  
- 3/16" side connects to Item 2  
- 1/4" side connects to sensor



*Item 2 - .25 LPM Flow Controller (P/N 478359)*

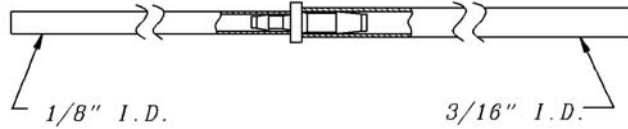


*Item 3 - Calibration Cap  
(P/N 710411)*

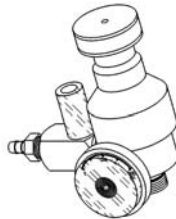


*Item 4 - Zero Cap  
(P/N 813774)*

**Figure 3-2. Calibration Kit 41 Contents**  
**(Your Kit may also include one or two gas cylinders)**

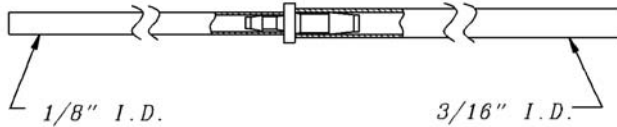


- Item 1 - Tubing (P/N 711113)  
 - 3/16" ID side connects to Item 2  
 - 1/8" ID side connects to Ultima or Toxgard II Sensor



Item 2 - Flow Controller, Match Flow (P/N 697344)

**Figure 3-3. Calibration Kit 42 Contents**  
 (Your Kit may also include one or two gas cylinders)



- Item 1 - Tubing (P/N 711113)  
 - 3/16" ID side connects to Item 2  
 - 1/8" ID side connects to Ultima or Toxgard II Sensor



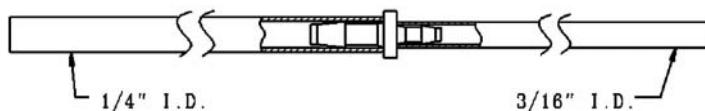
Item 2 - Flow Controller, Match Flow (P/N 697344)

**Figure 3-4. Calibration Kit 43 Contents**  
 (Your Kit may also include one or two gas cylinders)



## Calibration Kit 54

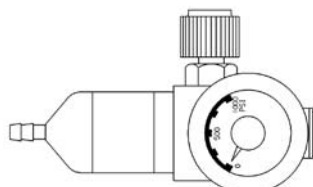
Calibration Kit 54 will calibrate diffusion Hydrogen Chloride Toxgard II Monitors (FIGURE 3-5).



- Item 1 - Tubing (P/N 711112)*  
 - 3/16" ID side connects to Item 2  
 - 1/4" ID side connects to sensor



*Item 2 - Zero Cap  
 (P/N 710535)*



*Item 3 - 1.5 LPM Flow  
 Controller (P/N 478358)*



*Item 4 - Desiccant  
 (P/N 10064306)*



*Item 5 - Calibration Cover  
 Assembly (P/N 10066581)*

**Figure 3-5. Calibration Kit 54 Contents**  
**(Your Kit may also include one or two gas cylinders)**  
**NOTE: Item 5 (P/N 10066581) is used**  
**only for SAFEMTX Calibration**

## Span Gas Values

The Toxgard II Monitor is factory-shipped with a preset span gas value that can be changed via the Controller (P/N 809086); otherwise, the span gas must correspond to preset concentrations. See TABLE 3-1 for factory-set span values.

### CAUTION

**To ensure a fully functional sensor, perform calibration checks and adjustments at initial start-up and at regular intervals.**

## Toxgard II Gas Monitor Calibration

The only true check of any gas monitor's performance is to apply gas directly to the sensor. The calibration procedure must be performed regularly.

### Calibration Documentation

The Toxgard II Monitor records the date of the last successful calibration. This date can then be displayed on the front-panel LED (with the use of the Controller) or transmitted to a Control Data Center if the Ultima Plus Digital Network option was purchased.

More frequent calibration may be required when the unit is new. Calibration frequency depends on operating time and chemical exposures of the instrument. Also perform calibration when installing or changing the power source of the control instrumentation. In some cases, it may be necessary to perform only a zero function of the Gas Monitor in lieu of a full zero and span procedure. Check with your safety officer or safety engineer to determine if only a zero function is necessary.

#### NOTES:

- If the sensor element has been changed or replaced, see Chapter 3, "Initial Calibration."
- If this is an oxygen sensor, see Chapter 3, "Oxygen Calibration."
- Before calibrating Chlorine, Nitrogen Dioxide, Hydrogen Chloride, Chlorine Dioxide, or Hydrogen Cyanide, apply power to the unit at least 1/2-hour before calibrating.

- Due to the unstable nature of Chlorine Dioxide ( $\text{ClO}_2$ ), Chlorine gas is used as a calibration simulant. If using the MSA calibration system and gas cylinder (P/N 710331), the response ratio is 2:1 (the 2-ppm sample of Chlorine should be set to read 1 ppm of  $\text{ClO}_2$ ). The default value for the calibration gas on the  $\text{ClO}_2$  Toxgard II Gas Monitor is 1 ppm.

## To Zero the Toxgard II Gas Monitor Only

NOTE: Combustible sensor configurations are only available with a remote sensor; side-mount and bottom mount sensors are not available in a combustible sensor configuration.

Identify your Toxgard II Gas Monitor and select the proper one of the following two zeroing calibration procedures.

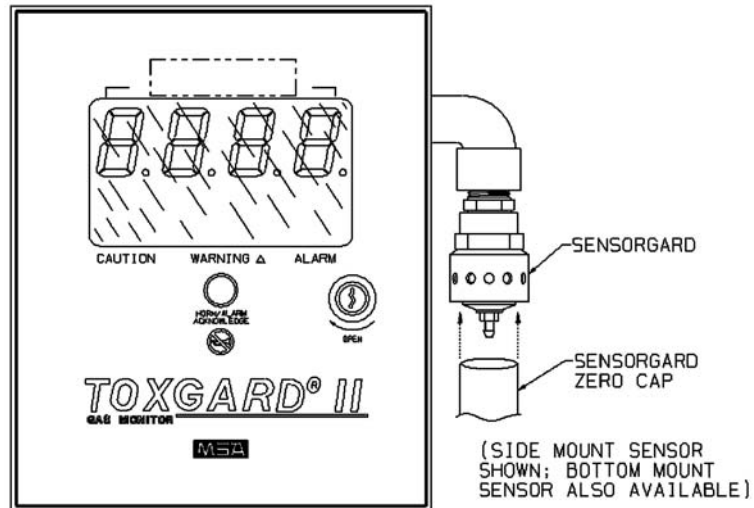
- Use Procedure Number 1 to zero your unit for the following gases:
  - Carbon Monoxide
  - Oxygen
  - Hydrogen Sulfide
  - Sulfur Dioxide
  - Hydrogen Chloride
  - Nitric Oxide
  - All Combustible gases.
- Use Procedure Number 2 to zero your unit for the following gases:
  - Chlorine
  - Nitrogen Dioxide
  - Chlorine Dioxide
  - Hydrogen Cyanide.

### Procedure Number 1

- This procedure uses items found in Calibration Kit 40, 42, and 54.
- For oxygen units, skip to Step 3.

#### 1. If Using the zero cap (FIGURE 3-6):

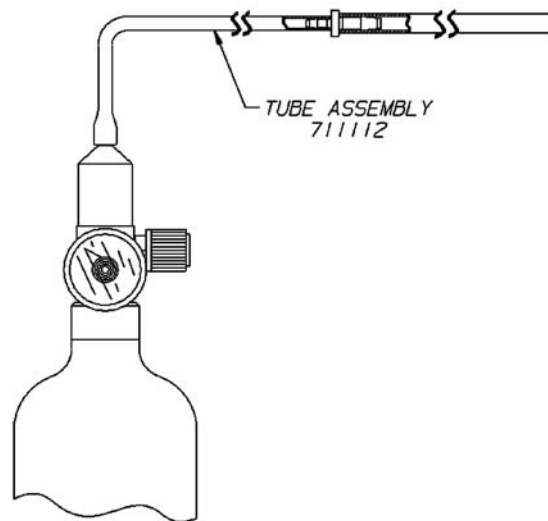
If the ambient air is suitable, with no traces of the gas of interest, place the zero cap (P/N 710535), from the Calibration Kit, over the SensorGard inlet and wait two minutes; otherwise, use zero gas.



**Figure 3-6. Zero Cap Placement**

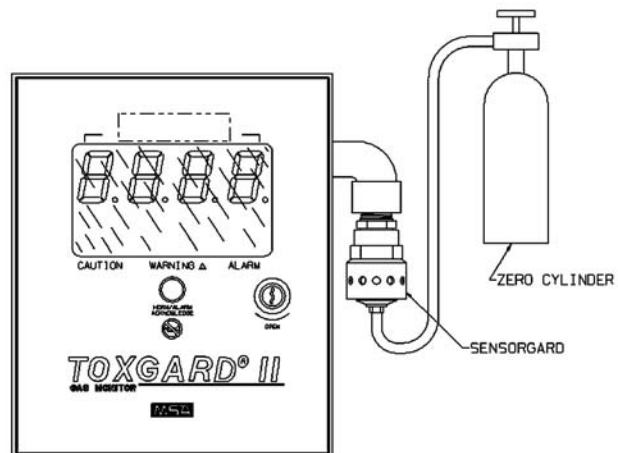
**2. If Using zero gas cylinder:**

- a. Locate the zero gas cylinder and the 1.5 LPM Flow Controller (P/N 478358).
- b. Screw the Flow Controller onto the top of the zero gas cylinder.
- c. Locate the Tube Assembly (P/N 711112).
- d. Push the smaller end of the Tube Assembly over the Flow Controller gas outlet.
  - Ensure tubing completely covers the gas outlet (FIGURE 3-7).



**Figure 3-7. Calibration Tubing Set-up**

- e. Connect the other end of the tubing over the SensorGard inlet (FIGURE 3-8).
- f. Turn on the gas flow by turning the knob on the flow controller.
  - Notice the open arrow on the flow controller knob.



**Figure 3-8. Zero Gas Connection**

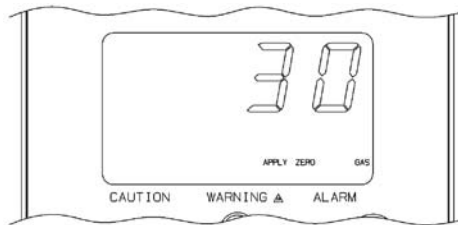
3. Point the Calibrator or Controller at the Toxgard II Gas Monitor display (FIGURE 1-2); press the ZERO button or push the right-hand internal CAL push-button (FIGURE 1-1) until the word "ZERO" appears; then, release.

NOTE: The zero or calibration process can be aborted at any time during the 30-second countdown interval; simply press any button on the Calibrator or Controller while aiming it at the unit or by pushing the internal push-button.

The 30-second countdown interval is omitted for oxygen units. It is electronically zeroed.

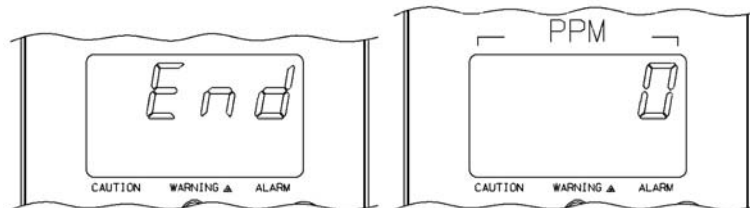
The display shows:

- A countdown from 30 to 0 seconds
- APPLY ZERO GAS (FIGURE 3-9)



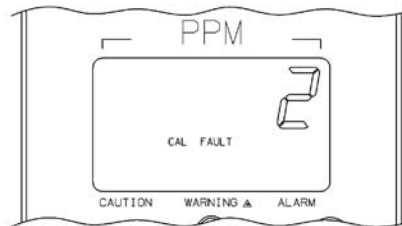
**Figure 3-9. Apply Zero Gas Flag**

4. After the 30 second countdown:
  - The display alternates between "CAL" and a value (for example: 0 PPM). This value is the actual reading of the gas concentration the sensor is detecting.
  - Once the gas value on the display is stable for 15 seconds, the alternating display stops. If the calibration is successful, the display will show END and 0 (FIGURE 3-10).



**Figure 3-10. Calibration End Display**

- a. **If using the zero cap:** remove it.
  - b. **If using a zero gas cylinder:**
    - 1) Turn OFF the gas flow by turning the flow controller knob.
    - 2) Remove the tubing from the SensorGard.
      - If the calibration signal is enabled during calibration, it will be held at the lockout value for an additional two minutes.
  - c. If a **CAL FAULT** flag appears on the unit (FIGURE 3-11), this indicates:
    - An unsuccessful attempt to zero or calibrate the Toxgard II Gas Monitor
    - The Toxgard II Gas Monitor is operating with the calibration parameters defined before the calibration was attempted.
- To extinguish the **CAL FAULT** flag, a complete calibration procedure must be performed.
- See Troubleshooting Guidelines found in Chapter 5.



**Figure 3-11. Calibration Fault Flag**

The Toxgard II Gas Monitor allows automatic zero adjustment only within a pre-defined range. It cannot make any corrections outside this range, such as when an empty or wrong cylinder of gas is applied or failure to begin gas flow within the allotted 30-second countdown occurs.

**5. If Using Zero Gas:**

After a successful zeroing, remove the tubing from the Flow Controller and remove the Flow Controller from the cylinder; return all items to their appropriate location in the Calibration Kit.

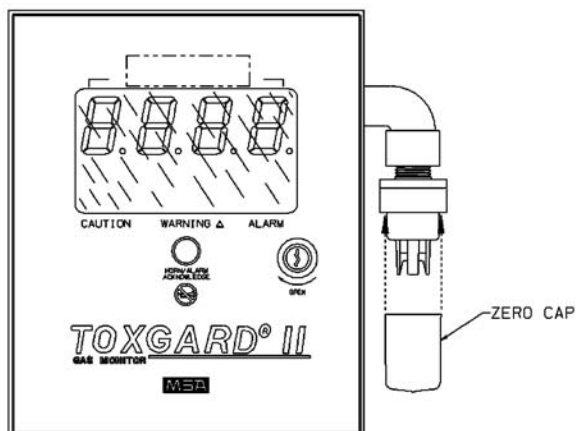
**If Using Zero Cap:**

Remove cap and return it to the Calibration Kit.

## Procedure Number 2

This procedure uses the items found in Calibration Kit 41 and 43.

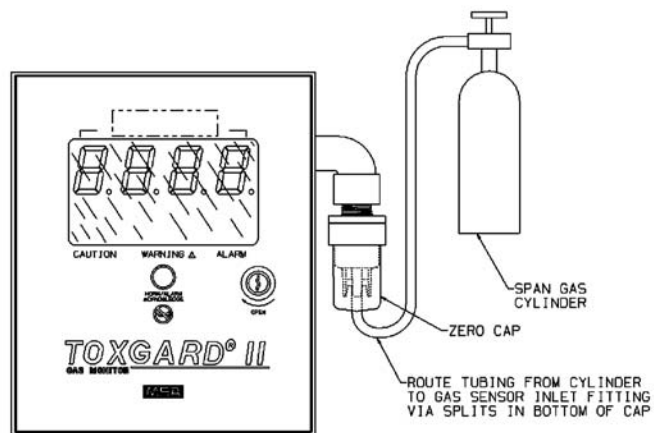
1. **If Using the Zero Cap (FIGURE 3-12):**  
If the ambient air is suitable, with no traces of the gas of interest, place the zero cap (P/N 813774) over the sensor inlet and wait two minutes; otherwise, use zero gas.



**Figure 3-12. Zero Cap Placement**

2. **If Using Zero Gas Cylinder:**
  - a. Locate the zero gas cylinder and the .25 LPM Flow Controller (P/N 478359).
  - b. Screw the Flow Controller onto the top of the zero gas cylinder.
  - c. Locate the Tube Assembly (P/N 711112).
  - d. Push the smaller end of the Tube Assembly over the Flow Controller gas outlet.
    - Ensure tubing completely covers the gas outlet (see FIGURE 3-6).
  - e. Connect the other end of the tubing over the SensorGard inlet (FIGURE 3-13).
  - f. Turn ON the gas flow by turning the knob on the flow controller.
    - Notice the open arrow on the flow controller knob.





**Figure 3-13. Zero Gas Connection**

3. Point the Calibrator or Controller at the Toxgard II Gas Monitor display (FIGURE 1-2) and press the ZERO button or push the right-hand internal push-button (FIGURE 1-1) until the word "ZERO" appears; then, release.

The display shows:

- A countdown from 30 to 0 seconds
- APPLY ZERO GAS (FIGURE 3-9)

NOTE: The zero or calibration process can be aborted at any time during the 30-second countdown interval; simply press any button on the Calibrator while aiming it at the unit or by pushing the internal push-button.

4. After the 30 second countdown:
  - The display alternates between "CAL" and a value (example: 0 PPM). This value is the actual reading of the gas concentration the sensor is detecting.
  - Once the gas value on the display is stable for 15 seconds, the alternating display stops. If the calibration is successful, the display will show END and 0 (FIGURE 3-10).
- a. **If Using the Zero Cap:** remove it.
- b. **If Using a Zero Gas Cylinder:**
  - 1) Turn OFF the gas flow by turning the flow controller knob.

2) Remove the tubing from the Sensor inlet.

- If the calibration signal is enabled during calibration, it will be held at the lockout value for an additional two minutes.

c. If a **CAL FAULT** flag appears on the unit (FIGURE 3-11), this indicates:

- An unsuccessful attempt to zero or calibrate the Toxgard II Gas Monitor
- The Toxgard II Gas Monitor is operating with the calibration parameters defined before the calibration was attempted.

To extinguish the **CAL FAULT** flag, a complete calibration procedure must be performed.

The Toxgard II Gas Monitor allows automatic zero adjustment only within a pre-defined range. It cannot make any corrections outside this range, such as when an empty or wrong cylinder of gas is applied or failure to begin gas flow within the allotted 30-second countdown occurs.

#### 5. If Using Zero Gas:

After a successful zeroing, remove the tubing from the Flow Controller and remove the Flow Controller from the cylinder; return all items to their appropriate location in the Calibration Kit.

### Perform a Complete Calibration

- If this is the first calibration after the sensor element is replaced, refer to "Initial Calibration."
- If this is an oxygen sensor, refer to "Oxygen Calibration".
- For Cl<sub>2</sub> and ClO<sub>2</sub> calibration, do not mix regulators. Use only one regulator (P/N 478359) for each of these gases. They will not work properly if one regulator is used for multiple gases.

Identify your particular Toxgard II Gas Monitor and select the proper one of the following two calibration procedures.

- Use **Procedure Number 1** to calibrate the Toxgard II Gas Monitor for the following gases:
  - Carbon Monoxide
  - Oxygen
  - Hydrogen Sulfide
  - Sulfur Dioxide

- Hydrogen Chloride
- Nitric Oxide
- All Combustible gases.
- Use **Procedure Number 2** to calibrate the Toxgard II Gas Monitor for the following gases:
  - Chlorine
  - Nitrogen Dioxide
  - Chlorine Dioxide
  - Hydrogen Cyanide.

#### **Procedure Number 1**

This procedure uses the items found in Calibration Kit 40, 42, and 54.

- For oxygen units, skip to Step 3.
- For Calibration Kit 54 diffusion Hydrogen Chloride, run HCL gas through flow control regulator and tubing for five minutes before starting a calibration. Dedicate this flow control regulator and tubing for use with HCL gas only.

#### **Zeroing**

##### **1. If Using the Zero Cap:**

If the ambient air is suitable, with no traces of the gas of interest, place the zero cap (P/N 710535), from the Calibration Kit, over the SensorGard inlet and wait two minutes; otherwise, use zero gas (FIGURE 3-6).

##### **2. If Using Zero Gas Cylinder:**

- a. Locate the zero gas cylinder and the 1.5 LPM Flow Controller (P/N 478358).
- b. Screw the Flow Controller onto the top of the zero gas cylinder.
- c. Locate the Tube Assembly (P/N 711112).
- d. Push the smaller end of the Tube Assembly over the Flow Controller gas outlet.
  - Ensure tubing completely covers the gas outlet (FIGURE 3-7).
- e. Connect the other end of the tubing over the SensorGard inlet (FIGURE 3-8).
- f. Turn on the gas flow by turning the knob on the flow controller.
  - Notice the open arrow on the flow controller knob.

3. Point the Calibrator or Controller at the Toxgard II Gas Monitor display (FIGURE 1-2); press the CALIBRATE button or press and hold the right-hand internal push-button for about five seconds until the word SPAN appears on the display. Release the button when SPAN is showing.

NOTE: The zero or calibration process can be aborted at any time during the 30-second countdown interval; simply press any button on the Calibrator or Controller while aiming it at the unit or press the internal push-button.

The 30-second countdown interval is omitted for oxygen units. It is electronically zeroed.

The display shows:

- A countdown from 30 to 0 seconds
- APPLY ZERO GAS (FIGURE 3-9)

4. After the 30 second countdown:

- The display alternates between "**CAL**" and a value (example: 0 PPM). This value is the actual reading of the gas concentration the sensor is detecting.
- Once the gas value on the display is stable for 15 seconds, the alternating display stops. If the calibration is successful, the display will show **END** and **0** (FIGURE 3-10).

a. **If using the zero cap:** remove it.

b. **If using a zero gas cylinder:**

- 1) Turn OFF the gas flow by turning the flow controller knob.
- 2) Remove the tubing from the Flow Controller.
  - If the calibration signal is enabled during calibration, it will be held at the lockout value for an additional two minutes.

c. If a **CAL FAULT** flag appears on the unit (FIGURE 3-11), this indicates:

- An unsuccessful attempt to zero or calibrate the Toxgard II Gas Monitor
- The Toxgard II Gas Monitor is operating with the calibration parameters defined before the calibration was attempted.

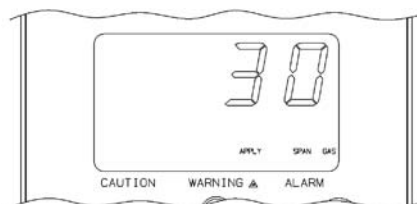
To extinguish the **CAL FAULT** flag, a complete calibration procedure must be performed.

- See Troubleshooting Guidelines found in Chapter 5.

The Toxgard II Gas Monitor allows automatic zero adjustment only within a pre-defined range. It cannot make any corrections outside this range, such as when an empty or wrong cylinder of gas is applied or failure to begin gas flow within the allotted 30-second countdown occurs.

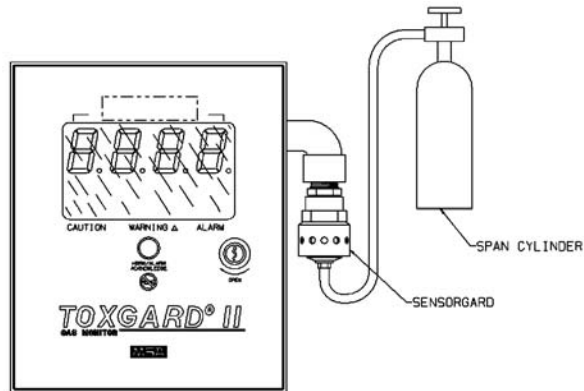
### Spanning

- If this is the first calibration after the sensor element is replaced, refer to "Initial Calibration."
  - If this is an oxygen sensor, refer to "Oxygen Calibration" later in this chapter.
5. The Toxgard II Gas Monitor automatically begins the span countdown after a successful zeroing of the unit. The span countdown is also 30 seconds (FIGURE 3-14).
    - The span process can be aborted at any time during the countdown by simply pressing any button on the Calibrator while aiming it at the unit or by pressing the internal push-button.



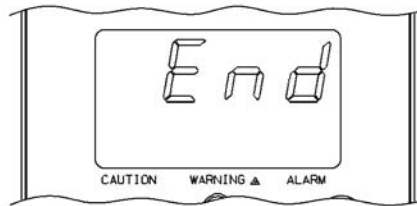
**Figure 3-14. Apply SPAN Gas Flag**

6. Turn OFF the zero gas and remove the flow controller, if used previously.
7. Locate the span gas cylinder and the 1.5 LPM Flow Controller (P/N 478358).
8. Screw the Flow Controller onto the top of the span gas cylinder.
9. Locate the Tube Assembly (P/N 711112).
10. Push the smaller end of the Tube Assembly over the gas outlet of the Flow Controller.
  - Ensure that the tubing completely covers the gas outlet (FIGURE 3-7).
11. Connect the other end of the tubing over the SensorGard inlet (FIGURE 3-15).



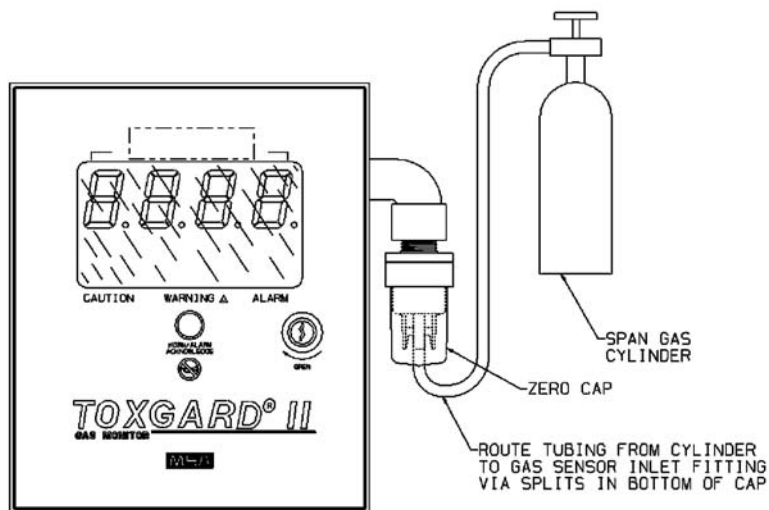
**Figure 3-15. Span Set-up**

12. Turn ON the gas flow by turning the flow controller knob.
  - Notice the open arrow on the knob of the flow controller.
  - If a **CAL FAULT** indication is on the Toxgard II Gas Monitor display before the user is able to apply the gas (FIGURE 3-11), a steady state gas condition existed for longer than 15 seconds; this caused the unit to use a wrong reading as a span indication.
    - It is necessary to restart the calibration process to clear this condition.
    - Ensure that any calibration gases are applied during the 30-second count down period.
    - It is good practice to have all calibration components previously assembled.
13. After the 30 second countdown:
  - The display alternates between "**CAL**" and a value. (for example: 60 PPM for 0 to 100 ppm carbon monoxide). This value is the actual reading of the gas concentration the sensor is detecting.
  - Once the gas value on the display is stable for 15 seconds, the alternating display stops. If the calibration is successful, the display will show **END** for approximately two seconds. (FIGURE 3-16).



**Figure 3-16. Calibration End Display**

- There are no adjustments necessary.
- The display will show the span gas value while the span gas is flowing to the unit. (For example, it may read 60 PPM or 25% or 60% LEL; FIGURE 3-17.)



**Figure 3-17. Span Gas Connection**

14. Turn OFF the gas flow by turning the knob on the flow controller.
  - If the calibration signal is enabled during calibration, it will be held at the lockout value for two additional minutes.
  - When the span gas is removed from the sensor, the sensor reading may drift for a few minutes; this is normal sensor operation.

- If a **CAL FAULT** flag appears on the unit (FIGURE 3-11), this indicates:
  - An unsuccessful attempt to calibrate the Toxgard II Gas Monitor
  - The Toxgard II Gas Monitor is operating with the calibration parameters defined before the calibration was attempted.

To extinguish the CAL FAULT flag, a complete calibration procedure must be performed.

The Toxgard II Gas Monitor allows automatic zero and span adjustments only within a pre-defined range. It cannot make any corrections outside this range, such as when an empty or wrong cylinder of gas is applied or failure to begin gas flow within the allotted 30-second countdown occurs.

15. After a successful calibration, remove the tubing from the Flow Controller and remove the Flow Controller from the cylinder; return all items to their appropriate location in the Calibration Kit.
16. For Calibration Kit 54 diffusion Hydrogen Chloride:
  - a. After a successful calibration, flush the flow control regulator and tubing with 100% Nitrogen for five minutes. Use this flow control regulator with Hydrogen Chloride gas only.
  - b. Store the flow control regulator and tubing in the desiccated sealed bag included in Calibration Kit 54 or equivalent dry container.

## Procedure Number 2

This procedure uses the items found in Calibration Kit 41 and 43.

### Zeroing

1. **If Using the Zero Cap** (FIGURE 3-12):

If the ambient air is suitable, with no traces of the gas of interest, place the zero cap (P/N 813774) over the sensor inlet and wait two minutes; otherwise, use zero gas.

2. **If Using Zero Gas Cylinder:**

- a. Locate the zero gas cylinder and the .25 LPM Flow Controller (P/N 478359).
- b. Screw the Flow Controller onto the top of the zero gas cylinder.
- c. Locate the Tube Assembly (P/N 711112).
- d. Push the smaller end of the Tube Assembly over the Flow Controller gas outlet.



- Ensure tubing completely covers the gas outlet (FIGURE 3-7).
- e. Connect the other end of the tubing over the SensorGard inlet (FIGURE 3-13).
- f. Turn on the gas flow by turning the knob on the flow controller.
  - Notice the open arrow on the flow controller knob.
- 3. Point the Calibrator at the Toxgard II Gas Monitor display (FIGURE 1-2) and press the Calibrator or Controller CALIBRATE button or press and hold the internal push-button for about five seconds until the word SPAN appears on the display. Release the button when SPAN is showing.

NOTE: The zero or calibration process can be aborted at any time during the 30-second countdown interval; simply press any button on the Calibrator or Controller while aiming it at the unit or pushing the internal push-button.

The display shows:

- A countdown from 30 to 0 seconds
- APPLY ZERO GAS (FIGURE 3-9)
- 4. After the 30 second countdown:
  - The display alternates between "**CAL**" and a value (example: 0 PPM). This value is the actual reading of the gas concentration the sensor is detecting.
  - Once the gas value on the display is stable for 15 seconds, the alternating display stops. If the calibration is successful, the display will show **END** and **0** (FIGURE 3-10).
  - a. **If Using the Zero Cap:** remove it.
  - b. **If Using a Zero Gas Cylinder:**
    - 1) Turn OFF the gas flow by turning the flow controller knob.
    - 2) Remove the tubing from the SensorGard.
      - If the calibration signal is enabled during calibration, it will be held at the lockout value for an additional two minutes.
  - c. If a **CAL FAULT** flag appears on the unit (FIGURE 3-11), this indicates:
    - An unsuccessful attempt to zero or calibrate the Toxgard II Gas Monitor

- The Toxgard II Gas Monitor is operating with the calibration parameters defined before the calibration was attempted.

To extinguish the **CAL FAULT** flag, a complete calibration procedure must be performed.

- See Troubleshooting Guidelines found in Chapter 5.

The Toxgard II Gas Monitor allows automatic zero and span adjustments only within a pre-defined range. It cannot make any corrections outside this range, such as when an empty or wrong cylinder of gas is applied or failure to begin gas flow within the allotted 30-second countdown occurs.

### Spanning

- If this is the first calibration after the sensor element is replaced, refer to "Initial Calibration."
  - If this is an oxygen sensor, refer to "Oxygen Calibration."
5. The Toxgard II Gas Monitor automatically begins the span countdown after a successful zeroing of the unit. The span countdown is also 30 seconds (FIGURE 3-13).
    - The span process can be aborted at any time during the countdown by simply pressing any button on the Calibrator while aiming it at the unit or by pressing the internal push-button.
  6. Turn OFF the zero gas and remove the flow controller if used previously.
  7. Locate the span gas cylinder and the .25 LPM Flow Controller (P/N 478359).
  8. Screw the Flow Controller onto the top of the span gas cylinder.
  9. Locate the Tube Assembly (P/N 711112).
  10. Push the smaller end of the Tube Assembly over the gas outlet of the Flow Controller.
    - Ensure that the tubing completely covers the gas outlet (FIGURE 3-7).
  11. Locate the calibration cap (P/N 710411) and push the tubing through the hole in the bottom of the cap.
  12. Connect the other end of the tubing over the Sensor inlet and push the calibration cap over the entire sensor inlet (FIGURE 3-17).
  13. Turn ON the gas flow by turning the flow controller knob.

- Notice the open arrow on the knob of the flow controller.
- If a **CAL FAULT** indication is on the Toxgard II Gas Monitor display before the user is able to apply the gas (FIGURE 3-11), a steady state gas condition existed for longer than 15 seconds; this caused the unit to use a wrong reading as a span indication.
- It is necessary to restart the calibration process to clear this condition.
- Ensure that any calibration gases are applied during the 30 second count down period.
- It is good practice to have all calibration components previously assembled.

14. After the 30 second countdown:

- The display alternates between "**CAL**" and a value (for example: 60 PPM for 0 to 100 ppm carbon monoxide). This value is the actual reading of the gas concentration the sensor is detecting.
- Once the gas value on the display is stable for 15 seconds, the alternating display stops. If the calibration is successful, the display will show **END** for approximately two seconds (FIGURE 3-16).
- There are no adjustments necessary.

The display will show the span gas value while the span gas is flowing to the unit. (For example, it may read 60 PPM or 25% or 60% LEL; FIGURE 3-17).

15. Turn OFF the gas flow by turning the knob on the flow controller.

- If the calibration signal is enabled during calibration, it will be held at the lockout value for two additional minutes.
- When the span gas is removed from the sensor, the sensor reading may drift for a few minutes; this is normal sensor operation.
- If a **CAL FAULT** flag appears on the unit (FIGURE 3-11), this indicates:
  - An unsuccessful attempt to calibrate the Toxgard II Gas Monitor
  - The Toxgard II Gas Monitor is operating with the calibration parameters defined before the calibration was attempted.

To extinguish the **CAL FAULT** flag, a complete calibration procedure must be performed.

The Toxgard II Gas Monitor allows automatic zero and span adjustments only within a pre-defined range. It cannot make any corrections outside this range, such as when an empty or wrong cylinder of gas is applied or failure to begin gas flow within the allotted 30-second countdown occurs.

16. After a successful calibration, remove the tubing from the Flow Controller and remove the Flow Controller from the cylinder; return all items to their appropriate location in the Calibration Kit.

## OXYGEN Calibration

NOTE: If this is the first calibration after the sensor element is replaced, perform an "Initial Calibration."

Oxygen calibration is slightly different from other gases. When the **ZERO** function is performed, the 30-second countdown is omitted because the Toxgard II unit performs the zero electronically. No calibration cap or zero gas is necessary.

To meet the stated specification, it is necessary to span the Oxygen Toxgard II Gas Monitor with the Calibration Kit and an oxygen cylinder. The concentration of oxygen-in-air varies slightly due to changing relative humidity levels. These variations in oxygen levels are detected by the oxygen Toxgard II Gas Monitor. To meet the reproducibility specification, a calibration gas cylinder must be used to ensure the same oxygen concentration for every calibration.

### 25% Oxygen Toxgard II Gas Monitor

For the **SPAN** function, ambient air is generally adequate for the 25% oxygen Toxgard II Gas Monitor as the expected default span value is 20.8%. Therefore, when the display prompts "**APPLY SPAN GAS**" it would be adequate to simply allow the countdown to occur without applying gas.

NOTE: If the sensor is located in an area of normally low or enriched oxygen, then a 20.8% oxygen sample must be applied when the display prompts: "**APPLY SPAN GAS**".

## INITIAL Calibration

When a new sensor element is placed in the sensor, an INITIAL Calibration must be performed. This procedure enables the unit to

gather data about the sensor to make accurate decisions for the **CHANGE SENSOR** function and the **CAL FAULT** function to work properly.

The *INITIAL* calibration is accomplished by aiming and pressing the **ZERO** and **CALIBRATE** buttons of the calibrator simultaneously or by pressing and holding the internal, right-hand button for about 10 seconds until the display shows "**ICAL**"; release the button when "**ICAL**" is showing.

- The display should show "**SET APPLY ZERO GAS**"
- The remainder of the procedure is now the same as that for a regular calibration.
- The presence of the words "**SET**" and "**ICAL**" on the display distinguish *INITIAL* Calibration from a regular calibration. If these words do not appear, abort the calibration; then, retry the above procedure.

NOTE: The zero or calibration process can be aborted at any time simply by pressing any button during the 30-second countdown on the Calibrator while aiming at the unit or by pressing the internal push-button.

- The display leads the user through the zero and span routines as in a regular calibration.

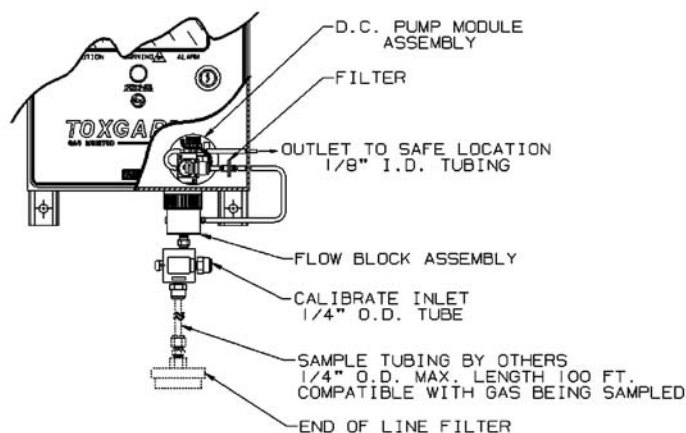
NOTE: This procedure must be initiated only when a new sensor element is installed.

## **Toxgard II Airline Monitor, Pumped Version and Aspirated Version Calibration (FIGURES 3-18 through 3-20)**

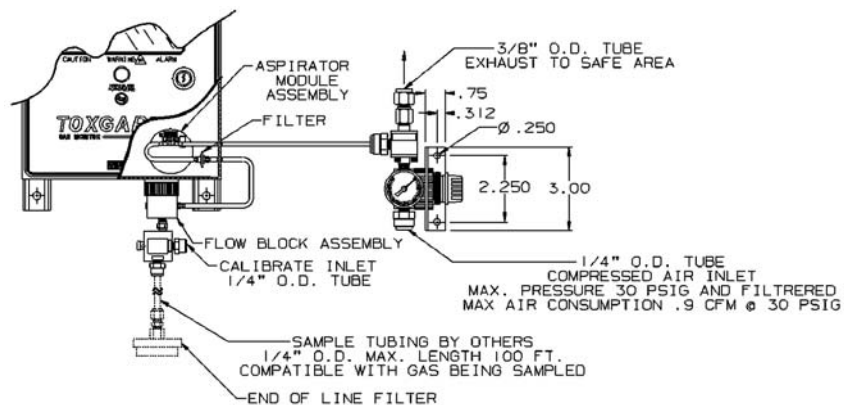
### **Calibration Procedure**

1. Install the Regulator/Flow Controller onto the Zero Gas Cylinder.
2. Connect the larger end of the Calibration Tube Assembly (3/16" ID) to the Cylinder Regulator.
3. Insert the smaller end of the tube assembly (1/8" ID) into the calibration fitting and tighten the nut.
4. Initiate the calibration procedure on the Toxgard II Air Line Monitor, Pumped or Aspirated versions.
5. Press and hold the calibration valve button.

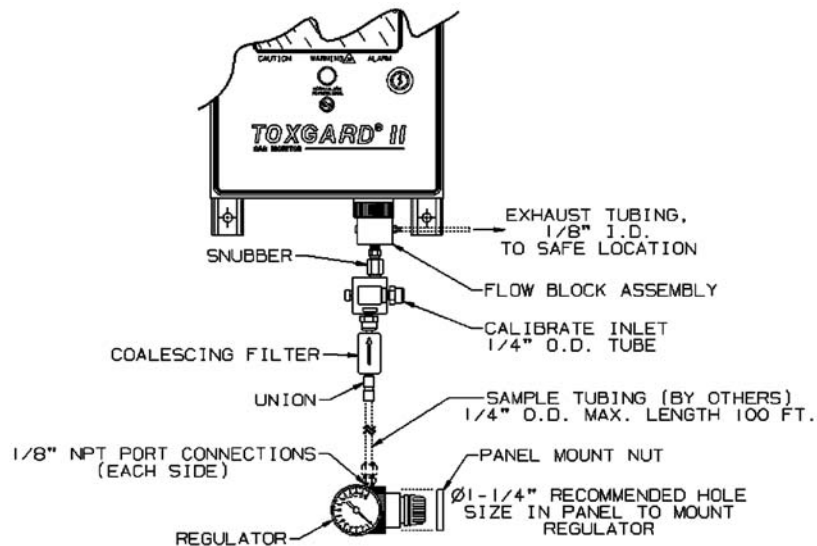
6. Open the Regulator/Flow Controller valve on the Gas Cylinder.
7. At the end of this sequence, the Toxgard unit displays **END**. Close the Regulator/Flow Controller valve and release the calibration valve button.
8. Remove the Zero gas and install the Regulator/Flow Controller onto the Span Gas Cylinder.



**Figure 3-18. Typical DC Pump Version Installation**



**Figure 3-19. Typical Air Aspirator Version Installation**



**Figure 3-20. Typical Air Line Monitor Installation**

9. Press and hold the calibration valve button.
10. Open the Regulator/Flow Controller valve on the Span gas cylinder and allow the gas to flow until the reading stabilizes and the unit displays **END**.
11. Close the Regulator/Flow Controller valve; then, release the calibration valve button.
12. Return the unit to normal operation.

#### **Zero Procedure**

1. Install the Regulator/Flow Controller onto the Zero Gas Cylinder.
2. Connect the larger end of the Calibration Tube Assembly (3/16" ID) to the Cylinder Regulator.
3. Insert the smaller end of the tube assembly (1/8" ID) into the calibration fitting and tighten the nut.
4. Initiate the Zero procedure on the Toxgard II Air Line Monitor, Pumped or Aspirated versions.

5. Press and hold the calibration valve button.
6. Open the Regulator/Flow Controller valve on the gas cylinder.
7. At the end of this sequence, the Toxgard unit displays **END**.  
Close the Regulator/Flow Controller valve and release the calibration valve button.
8. Return the unit to normal operation.



## Chapter 4, Specifications

**Table 4-1. Specifications**

<b>GAS TYPES</b>		Combustibles, Oxygen & Toxics	
<b>TEMPERATURE RANGE</b>	<b>TOXICS &amp; OXYGEN</b>	<b>OPERATING RANGE:</b>	0 to 40°C (32 to +104°F)
		<b>*EXTENDED RANGE:</b>	-20 to +50°C (-4 to +122°F) (Calibrate within operating range)
	<b>COM-BUSTIBLES</b>	<b>DUAL MODULE:</b>	-40 to +90°C (-40 to +194°F)
<b>DRIFT</b>	<b>ZERO DRIFT</b>	Less than 5%/year, typically	
	<b>SPAN DRIFT</b>	Less than 10%/year, typically	
<b>NOISE</b>		Less than 1% FS	
<b>ACCURACY</b>	<b>GAS</b>	<b>LINEARITY</b>	<b>REPEATABILITY</b>
	CARBON MONOXIDE	the greater of ±2% full scale (FS)	±1% FS or 2 ppm
	OXYGEN	±2% FS	±1% FS
	HYDROGEN SULFIDE	±10% FS or 2 ppm	±1% FS or 2 ppm
	CHLORINE	±10% FS or 2 ppm	±5% FS or 1 ppm
	SULFUR DIOXIDE	±10% FS or 2 ppm	±1% FS or 2 ppm
	NITRIC OXIDE	±10% FS or 2 ppm	±1% FS or 2 ppm
	NITROGEN DIOXIDE	±10% FS or 2 ppm	±4% FS or 1 ppm
	HYDROGEN CYANIDE	±10% FS or 2 ppm	±4% FS or 2 ppm
	HYDROGEN CHLORIDE	±10% FS or 2 ppm	±10% FS or 2 ppm
	COMBUSTIBLE GAS, H <sub>2</sub>	±2% of scale	±1% FS
	COMBUSTIBLE GAS, PETROLEUM VAPORS	±2% of scale	±1% FS
	COMBUSTIBLE GAS, SOLVENTS	±2% of scale	±1% FS
	CHLORINE DIOXIDE	±10% FS or 2 ppm	±5% FS or 1

\*Extended Range = The sensor may not meet all of the accuracy parameters listed.

STEP CHANGE RESPONSE	TIME TO REACH 20% OF SCALE - OXYGEN & TOXICS	Less than 12 seconds (typically 6 seconds)	
	TIME TO REACH 50% OF SCALE - OXYGEN & TOXICS	Less than 30 seconds (typically 12 seconds)	
	TIME TO REACH 50% OF SCALE - COMBUSTIBLES	Less than 10 seconds	
	TIME TO REACH 90% OF SCALE - COMBUSTIBLES	Less than 30 seconds	
HUMIDITY		15 to 95% RH, non-condensing <sup>1</sup>	
ALTITUDE		±10,000 feet (3,000 meters)	
SENSOR LIFE	COMBUSTIBLES	3 years, Typically	
	OXYGEN & TOXICS	2 years, Typically	
	FULL REPLACEMENT WARRANTY	1 year	
HAZARDOUS AREA RATING		General-purpose only. Check Area Rating of Remote Sensor for allowable applications	
WIRING REQUIREMENTS	mA OUTPUT	OXYGEN & TOXICS	2-wire
		COMBUSTIBLES	2-wire
POWER INPUT	OXYGEN & TOXICS	120 - 220 VAC ±10%, 50/60 Hz, 40 VA max	
	COMBUSTIBLES	120 - 220 VAC ±10%, 50/60 Hz, 40 VA max	
	REMOTE SENSOR	Supplied by Toxgard II Monitor	
SIGNAL OUTPUT	4-20 mA	COMBUSTIBLES	current source
		OXYGEN & TOXICS	current source
	DIGITAL	See Ultima Plus specifications	
RELAY OUTPUTS	5 AMP WITH 120-240 VAC; 5 AMPS WITH 30 VDC	Three levels of Alarm and One Fault Relay	
PHYSICAL	SIZE	16 x 23.3 x 5 inches (40.6 x 59.2 x 12.7 cm) max.	
	WEIGHT	13 pounds (5.9 kilograms)	
BEACON	CHARACTERISTICS	Strobe type 70 to 90 flashes per minute	
	INTENSITY	RED AMBER	55 candella eff. 230 candella eff.

<sup>1</sup> Maximum relative humidity 80 percent for temperatures up to 31°C; decreasing linearly to 50 percent relative humidity at 40°C.

<b>HORNS</b>	<b>PIEZO</b>	75 db at five feet
	<b>FEDERAL</b>	95 db at five feet
	<b>BANSHEE</b>	100 db at three feet
<b>HAZARDOUS RATING</b>	<b>NORMAL CONFIGURATION</b>	General-purpose unit
	<b>CLASS I, DIVISION 2 CONFIGURATION</b>	Unit can be configured to meet Class I, Division 2 Areas; this configuration will not have relays, pumps, batteries, autocalibration, or horns as options (it will have the standard Piezo alarm buzzer)
<b>APPROVAL PARAMETERS</b>		Installation Category II Pollution Degree 2

**⚠ WARNING**

**Explosion Hazard: Substitution of components may impair suitability for Class I, Division 2.**

**Explosion Hazard: Do not disconnect equipment unless power has been switched OFF or the area is known to be non-hazardous.**

## **Chapter 5, Maintenance**

### **General**

The Toxgard II Monitor may be cleaned with a dry soft cloth and requires minimal periodic maintenance to assure trouble-free operation. However, the response to gas must be checked regularly to assure the instrument is functioning.

NOTE: The only way to verify an instrument is functioning properly is to perform a calibration test. This test does not necessarily mean the unit must be adjusted, but that it must be checked with ZERO and SPAN gas, and observed for acceptable readings.

The more frequent the calibration tests, the greater the chances for early detection of instrument failure resulting from instrument component failure, damage or power loss.

Maintain a written log of instrument readings obtained during calibration. Increase the frequency of calibration tests when the sensor nears end-of-service life, or when abnormally high variations with respect to the instrument log are observed.

The only routine maintenance item is the sensing element itself, which has a limited lifetime. When the Toxgard II Monitor's read-out indicates that the sensor must be changed, there is very little sensor lifetime remaining. It is good practice to obtain a replacement sensing element before the sensing element within your unit becomes inoperative.

The Toxgard II Monitor is constantly performing a self-check. When a problem is found, it displays the appropriate error code. (Table 5-1, "Troubleshooting Guidelines"). When an error is detected within the unit, the mA output signal falls to 0 mA.

- The "Change Sensor" indication is not an error and does not affect the output.

### **Corrective Maintenance**

See TABLE 5-1, "Troubleshooting" to identify an inoperative assembly in the Toxgard II monitor; then, replace it according to the following procedures.

## Sensor Replacement

Typically, the Toxgard II Monitor LED display shows a maintenance message when the sensor is due for replacement (FIGURE 5-1).

1. To replace the sensor, remove power from the Toxgard II Monitor.

### **⚠ WARNING**

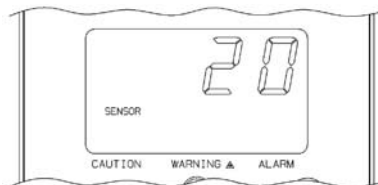
Before removing the cover of an explosion-proof Toxgard II Monitor, sample the area around the enclosure with a portable combustible gas indicator (such as the MSA Passport<sup>®</sup> Personal Alarm) to make sure the surrounding area does not contain a flammable mixture of combustible gas and air. When the enclosure is open and connected to power, a source of ignition exists which could cause the explosion of combustible gas, resulting in damage, serious personal injury and death.

Handle the sensor carefully; the electrochemical version is a sealed unit which contains a corrosive electrolyte. If electrolyte is leaking from the sensor, exercise CAUTION to ensure the electrolyte does not contact skin, eyes or clothing, thus avoiding burns. If contact occurs, rinse the area immediately with a large quantity of water. In case of contact with eyes, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

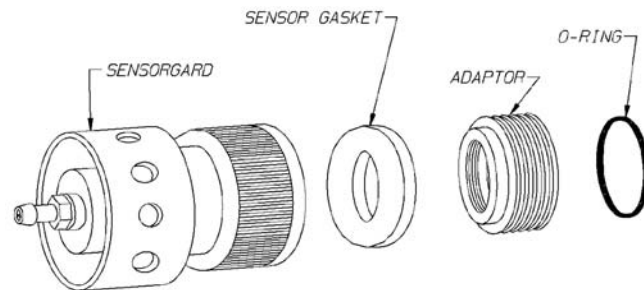
### **⚠ CAUTION**

Do not install a leaking sensor in the sensing head assembly. The leaking sensor should be disposed of in accordance with local, state and federal laws. To obtain a replacement sensor, contact MSA at the address given under "Obtaining Replacement Parts."

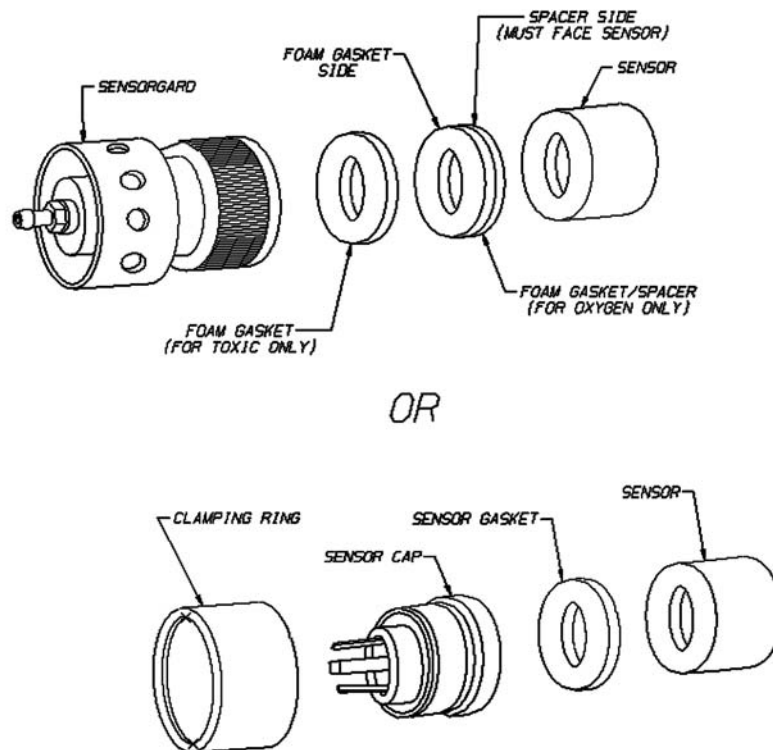
2. There is no need to open the main or remote enclosure; simply unscrew the cap located on the bottom of the sensor assembly (FIGURES 5-2 through 5-4). For combustible versions, unscrew the gas-tight union (see FIGURE 1-6).



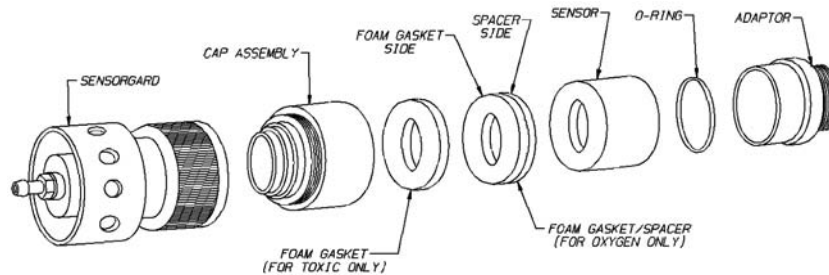
**Figure 5-1. Change Sensor Flag**



**Figure 5-2. Cap Location for Remote Combustible Gas Explosion-proof Sensor**



**Figure 5-3. Cap Location for Toxic Gas or Oxygen General-purpose Model**

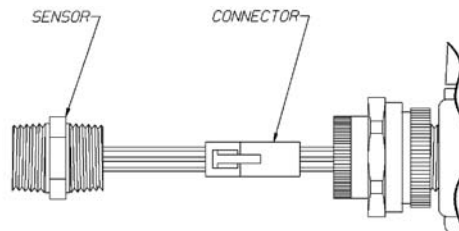


**Figure 5-4. Cap Location for Remote Toxic Gas or Oxygen Explosion-proof Sensor**

3. Identify the sensor element needed and obtain the same type of sensor element.
4. **Toxic or Oxygen Sensors:**  
Unplug the sensor by pulling it straight down; properly dispose of sensor.

**Combustible Sensors:**

- Combustible units have a three-pin connector; pry out the locking clip and pull apart the connector (FIGURE 5-5).



**Figure 5-5. Combustible Three-Pin Connector**

5. **Toxic or Oxygen Sensors:**  
Before installing the sensor, check the pins of the sensor for a shorting clip; remove the shorting clip and the label beneath the clip before installing the sensor. Install the new sensor by aligning the pins; do not force onto pins.

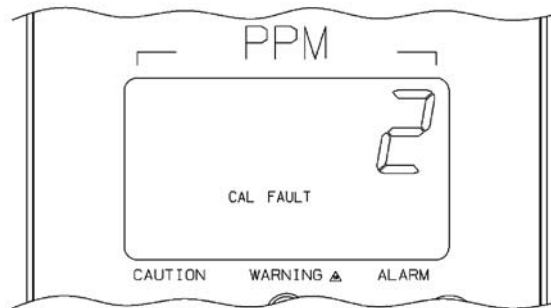
### Combustible Sensors:

Connect the three-pin connector on the new sensor (FIGURE 5-5). Carefully reconnect the union, taking care not to pinch the wires.

#### **⚠ CAUTION**

**Do not over-tighten the sensor on the inlet fitting; otherwise, damage to the sensor may result.**

6. Re-apply power to the Toxgard II Monitor.
7. Perform the **INITIAL** Calibration Procedure as outlined in the Toxgard II Monitor Calibrator or Toxgard II Monitor Controller instruction manual. This procedure differs slightly from a standard calibration procedure. Use of the **INITIAL** calibration procedure upon installation of a new sensor ensures the Toxgard II Monitor will perform a successful calibration. Failure to do so may result in a CAL FAULT reading (FIGURE 5-6).



**Figure 5-6. CAL FAULT Reading**

It is recommended that all other maintenance be performed at an MSA factory-authorized service center. See TABLE 5-1 for troubleshooting guidelines.



**Table 5-1. Troubleshooting Guidelines**

<b>SYMPTOM</b>	<b>POSSIBLE CAUSE</b>	<b>CORRECTIVE ACTION</b>
Unit will not power up properly	Insufficient voltage or current from power supply. Incorrect wiring connections. Wire strands touching at input terminal block	Check power supply and interconnecting wires
Display shows <b>CAL FAULT</b>	Cell signal too low or too high during calibration. Unstable calibration signal	Check calibration gas and flow system; then, recalibrate (valid calibration or Initial Calibration will clear display)
	Old or damaged cell	Replace cell and perform <b>Initial</b> Calibration. (If original cell is new, an <b>Initial</b> Calibration alone may solve the problem)
	Failed autocal calibration	If the unit is incorrectly set up for autocal, disable the autocal mode by setting the future calibration date to 12-31-1993 or check autocal flow system
Display shows <b>CAL</b>	Sensor cell replacement was detected or display was factory-set	Perform <b>Initial</b> Calibration if unit is new or cell was replaced. Perform regular calibration if same cell was re-installed
Display flashes <b>Err 1*</b>	Sensor cell detected as missing	Inspect cell for proper placement. After recovery, see above SYMPTOM: "Display shows <b>CAL</b> "
	Damaged sensor body	Replace sensor body and perform <b>Initial</b> Calibration
Display flashes <b>Err 2</b>	Invalid cell type	Replace or repair main board
Display flashes <b>Err 3</b>	Non-volatile memory not detected	Cycle power or repair main board
Display shows <b>Err 4</b>	Non-volatile memory reset or not initialized (Cell type changed)	Perform Initial Calibration
	Damaged sensor or sensor body	Replace sensor or sensor body and perform initial calibration

**\*Hydrogen Cyanide, Hydrogen Chloride and Sulfur Dioxide Sensors**

NOTE: This NOTE and the following CAUTION apply to the Toxgard II Series sensors for Hydrogen Cyanide (HCN), Hydrogen Chloride (HCL) and Sulfur Dioxide (SO<sub>2</sub>) only. The Toxgard II Series product line contains a sensor detection function to alert the user of a sensor disconnection problem by displaying "ERR 1" on the LCD display.

**▲ CAUTION**

The sensor detection function is **NOT** present in the HCN, HCL, SO<sub>2</sub> or 100 ppm H<sub>2</sub>S version of the Toxgard II series. Therefore, an HCN, HCL or SO<sub>2</sub> sensor disconnection will **NOT** be indicated by an "ERR 1" display. A periodic check with a known concentration of calibration gas must be performed regularly to ensure proper sensor function. See "Calibration" portion of Chapter 2 in this manual for calibration instructions.

<b>SYMPTOM</b>	<b>POSSIBLE CAUSE</b>	<b>CORRECTIVE ACTION</b>
Display flashes <b>Err 6</b>	Battery power exhausted	Connect to line power for recharge
Output signal not present	Wiring error	Check connections
	<b>Initial</b> Calibration was not performed	Perform Initial Calibration
	Sensor cell missing	See SYMPTOM: "Display flashes <b>Err 1</b> "
	Sensor signal under-range	See SYMPTOM: "Display shows <b>UND</b> "
	Error detected	See "Symptom" column for specific error
Display shows <b>SENSOR</b>	Sensor cell output is below acceptable signal level	Replace sensing cell and perform an <b>Initial</b> Calibration
No response to manual ZERO or CAL command	Unit is set up for AUTOCAL use, but autocal unit or gases are not present	De-activate AUTOCAL mode by setting Future Calibration date to 12-31-1993
Display shows <b>UND</b>	Cell signal is under-range	Perform regular zero or full calibration. If calibration fails, see above SYMPTOM: "Display shows <b>CAL FAULT</b> ". If UND persists, replace cell and perform <b>Initial</b> Calibration.  NOTE: Although sensor output is not present during <b>UND</b> condition with no gas present, output will correctly respond to the presence of gas. When gas is no longer present, output will no longer be present. This function serves to alert the user that an abnormal condition exists and calibration or other maintenance is required
Low gas reading	Clogged sensor water stop disc	Clean or replace disc
	Misaligned stop disc	Re-align disc and gasket
	Poor gas flow or damaged cell	See SYMPTOM "Display shows <b>CAL FAULT</b> "
Display shows <b>LO FLO</b>	Restricted air flow	Clear tubing
	Pump inoperative	Replace pump

## Obtaining Replacement Parts

See TABLE 5-2 for replacement sensor kits. To obtain a replacement sensor, address the order or inquiry to:

**Mine Safety Appliances Company**  
**1000 Cranberry Woods Drive, Cranberry Township, PA 16066**  
**or call, toll-free, 1-800-MSA-INST.**

### **WARNING**

Use only genuine MSA replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair sensor performance. Repair or alteration of the Toxgard II Monitor, beyond the scope of these maintenance instructions or by anyone other than authorized MSA service personnel, could cause the product to fail to perform as designed and persons who rely on this product for their safety could sustain serious personal injury or death.

**Table 5-2. Replacement Sensor Kits**

<b>GAS</b>	<b>SENSOR KIT PART NO.</b>
Carbon Monoxide, 0-100 ppm	813613
Carbon Monoxide, 0-500	813613
Sulfur Dioxide, 25 ppm	813615
Hydrogen Sulfide, 10 ppm and 50 ppm	813616
Hydrogen Sulfide, 100 ppm	813618
Nitrogen Oxide, 100 ppm	813619
Nitrogen Dioxide, 10 ppm	813620
Chlorine or Chlorine Dioxide	710967
Hydrogen Cyanide, 50 ppm	813622
Hydrogen Chloride, 100 ppm	813623
Oxygen, 0-25%	813723
Combustible Gas, 100% LEL	813624

**SENSORGARD REPLACEMENT PARTS**

General-purpose CO, H <sub>2</sub> S, SO <sub>2</sub> and NO	710222
General-purpose Oxygen	710225
General-purpose Cl <sub>2</sub> , ClO <sub>2</sub> , NO <sub>2</sub> HCL and HCN	812075
Combustible	710436
Sensorgard gasket	812152

**NOTE:**

Contact 1-800-MSA-INST for factory support in determining the appropriate part numbers for explosion-proof or duct mount Sensorgards

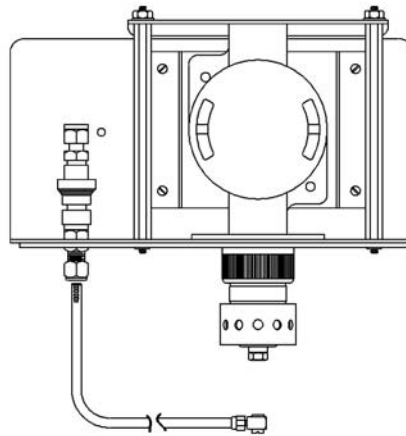
**Table 5-3. Spare Parts List**

ITEM	PART NO.
Main printed circuit board	NOTE: Order this replacement board according to information provided on the label of the existing board. This label should read:  <b>"A-TOX-PCB-X-Y-Z"</b>  (X-Y-Z corresponds to the first, sixth and seventh option code positions found on the nameplate of the main unit)  Contact 1-800-MSA-INST for factory-support in determining the appropriate part number
Display printed circuit board	711033
Plastic Support, display printed circuit board	655654
Strobe, red	634674
Strobe, gasket	711168
Battery	655759
Power supply	655623
Piezo Buzzer	637123
Horn, federal	655656
Pump kit, DC	711169
Pump kit, aspirated	711213
Air line flow assembly	711267
Autocal assembly	813675
Valve assembly, general-purpose	813125
Valve assembly, explosion-proof	813243

## Appendix A Optional Duct Mount Kit

### General

The Remote Sensor Duct Mount Kit (FIGURE A-1) provides convenient sampling of gas within an air duct.



**Figure A-1. Ultima Duct Mount Kit**

- This Kit enables duct gas sampling even when flow rate within the duct is at a high velocity.
- The user can calibrate the sensor via a calibration port without disassembling or removing the sensor from the duct.
- The sensor and the Kit are sealed to the duct to prevent gas within the duct from escaping.
- All Toxgard II remote sensors fit into the remote sensor model of the Duct Mount Kit.

The Remote Sensor Module Duct Mount Kit:

- Allows the sensor portion of the unit to be mounted on the duct (perhaps in an inaccessible location), while the read-out and calibration portion are placed in an easily accessible location to:
  - save valuable maintenance time and money
  - enhance calibrator safety.

## Mounting

### General

Mounting the Remote Sensor on a duct is easily done with the Duct Mount Kit. The proper location on the duct will permit your sensor to operate up to its potential.

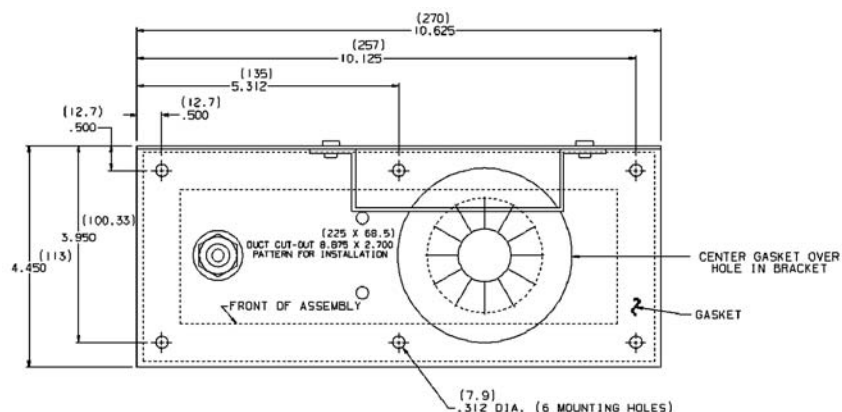
Choose a location on the duct:

- Where the duct is flat or level:
  - The Duct Mount Kit will not mount on a diameter of less than eight inches (203 mm) of rounded or curved duct work.
  - Additional gasketing may be necessary to properly seal the unit.
- As far away from any bends or tees as possible, as those locations may have additional turbulence
- Where reasonable access is possible to enable sensor replacement
- That keeps the sensor pointing downward:
  - It is good practice to mount the sensor on horizontal run of the duct.
  - Mount the sensor on top of the duct to allow water and dirt to naturally drip off the sensor within the duct and prevent clogging.
- That allows the dual module sensor calibration gas tubing to be routed to the read-out module. Any gas-compatible tubing can be used (not supplied in Kit)
  - Keep this tubing as straight and short as possible.
- Beyond any filter or cleaning unit
- Away from the lowest point on the duct, which tends to collect additional dirt and dust
- Away from any fans or blowers.

The Duct Mount Kit requires some assembly before mounting. It is necessary to temporarily remove the sensor from the module housing and install the sealing gaskets. All necessary hardware is provided in the Kit.

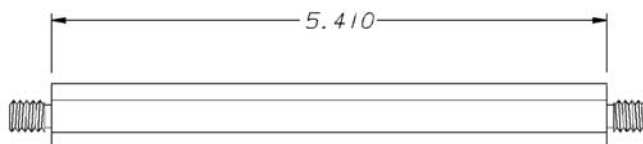
## Mounting

1. Locate the duct to be sampled.
2. Cut a rectangular hole [8.875 by 2.7 inches (225 by 68.5 mm)] in the duct (FIGURE A-2).
  - The gasket on the bottom of Duct Mount Kit must sit flat on the duct.
  - If necessary, pre-drill the fastener holes.
  - Do not remove the gasket paper lining on the Duct Mount Kit at this time.
  - On rounded ducts, additional gasketing may be required for proper sealing.



**Figure A-2. Duct Template**

3. Locate and identify all components in the Duct Mount Kit (TABLE A-1).



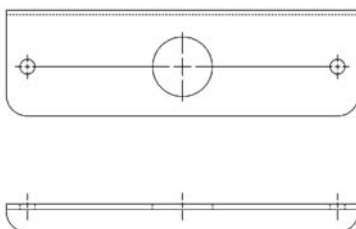
**Figure A-3. Remote Sensor Spacers**



**Table A-1. Dual Module Duct Mount Kit Parts List**

DESCRIPTION	PART NUMBER	FIGURE
Two Toxgard II Gas Monitor Spacers	710779	A-12
Toxgard II Gas Monitor Clamp	710778	A-13
Toxgard II Gas Monitor Enclosure Gasket	710770	A-6
Toxgard II Gas Monitor Plate	710769	A-7
Toxgard II Gas Monitor Duct Mount Kit Base Plate	814862	A-14
Two 1/4-inch Hex Nuts	631357	
Two 1/4-inch Lock Washers	655245	
Six 10-32 Screws	634054	
Six #10 Lock Washers	627852	

4. Locate the Remote sensor of the Toxgard II Gas Monitor to be installed in the duct.
5. Unscrew the cover of the Remote sensor and set aside.



**Figure A-4. Remote Sensor Clamp**

**⚠ WARNING**

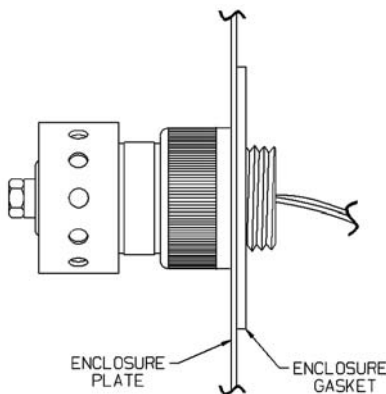
Before removing the cover of an explosion-proof Remote Sensor Toxgard II Gas Monitor, verify that the surrounding area does not contain a flammable mixture of combustible gas and air, since a source of ignition is exposed; otherwise, an explosion may occur if a metal object contacts the circuitry and produces sparks.

6. **For Toxic or Oxygen Remote Sensor Toxgard II Gas Monitors:**  
To disconnect the sensor wiring on the termination printed circuit board in the module, pull up on the connector inserted into J1 (FIGURE 1-9).

**For Combustible Remote Sensor Toxgard II Gas Monitor:**

To disconnect the sensor wiring on the termination printed circuit board in the module, unscrew or loosen the screws on the terminal wiring connector.

- Before removing the wires, mark the identity of each wire to permit proper replacement (FIGURE 1-8).
7. To avoid damage, completely remove the black SensorGard by unscrewing the black plastic ring.
  8. Using a strap or pipe wrench, carefully unscrew the sensor body from the module.
    - Carefully remove sensor assembly from the sensor body.
    - Ensure that wires and connector do not break when removing the sensor body.
  9. Place the enclosure plate and gasket from the Duct Mount Kit on the sensor body threads (FIGURE A-5).



**Figure A-5. Sensor**

10. Carefully feed the sensor wires from the sensor body back into the module opening.
11. Using a strap or pipe wrench, carefully screw the sensor body back into the module.
  - Ensure that gasket is centered and not folded on the sensor threads.

**12. For Toxic or Oxygen Remote Sensor Toxgard II Gas Monitors:**

Re-connect the sensor wiring on the termination printed circuit board in the module by aligning the connector and inserting it into J1 (FIGURE 1-9).

**For Combustible Remote Sensor Toxgard II Gas Monitor:**

Re-connect the sensor wiring onto the wiring termination printed circuit board in the module (FIGURE 1-8).

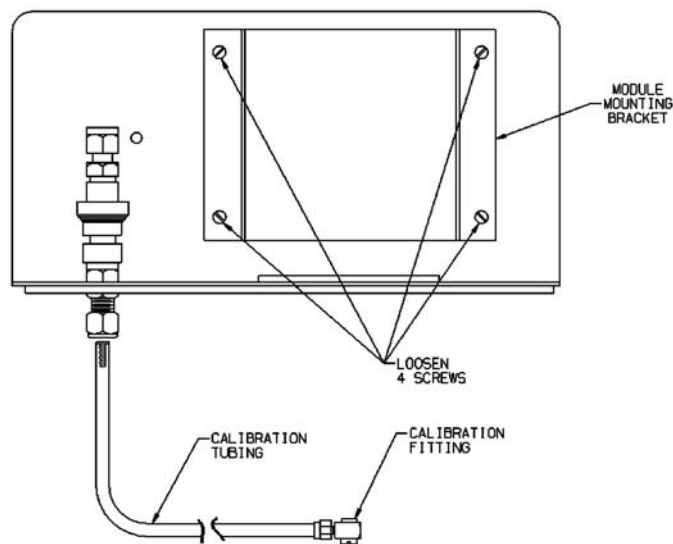
**13. Re-install the cover of the Remote Sensor Toxgard II Gas Monitor.**

**⚠ WARNING**

**Do not let the cover remain off of an explosion-proof Remote Sensor Toxgard II Gas Monitor. Since a source of ignition is exposed, an explosion may occur if a metal object contacts the circuitry and produces sparks in an atmosphere of combustible gas.**

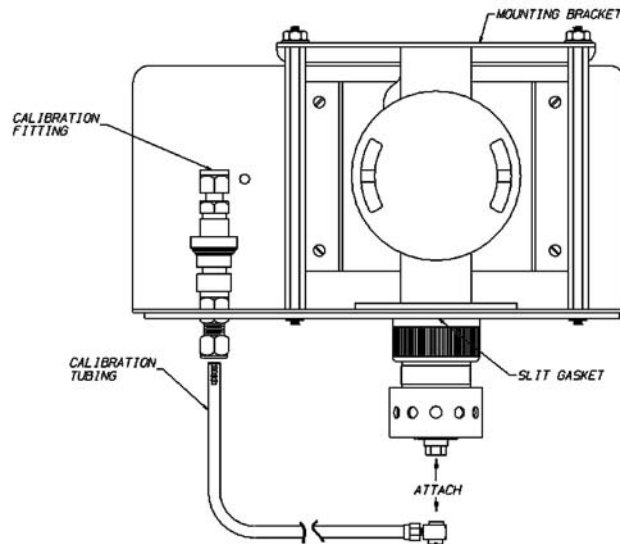
**14. Locate the Remote sensor Toxgard II Gas Monitor base plate and two #10-32 screws and lock washers.**

**15. Remove the four screws holding the module mounting bracket (FIGURE A-6).**



**Figure A-6. Remote Sensor Base Plate**

16. Fasten the Remote Sensor module to the bracket using two 10-32 screws and lock washers.
  - These screws pass through the bracket and into two tapped holes in the module.
17. Push the Remote sensor Toxgard II Gas Monitor through the slit gasket on the Duct Mount base plate (FIGURE A-7).
18. Fasten the sensor module bracket to the base plate using the 10-32 screws removed in step 15.
  - Do not tighten completely.
19. Fasten the calibration tubing fitting into the center post of the SensorGard (FIGURE A-7).



**Figure A-7. Duct Mount and Sensor**

20. Locate the two Remote sensor Toxgard II Gas Monitor spacers. Screw one end of each spacer into the Duct Mount Kit base plate.
21. Place the Remote sensor Toxgard II Gas Monitor clamp on the top of the spacers.
  - Ensure the folded part of the clamp is mounted on the back side of the Remote Sensor Toxgard II Gas Monitor.
22. With the 1/4-inch hex nut and lock washers, secure the clamp onto the spacers (FIGURE A-7).

- Tighten the #10-32 screws that secure the module mounting bracket to the base plate.
23. Clean the area around the hole made in step 2.
    - Ensure that no grease, metal shavings or other material is in the area where the gasket will be seated.
  24. Remove the protective paper backing from the gasket found on the bottom of the Duct Mounting flange.
  25. Install the entire assembly on the duct. Use proper fasteners to secure the Toxgard II Gas Monitor Duct Mount to the duct.
  26. If necessary, tape or seal around the sensor gasket to prevent leaks.
  27. Remove the top half of the calibration fitting and connect it to your calibration tubing.
    - When calibrating, push the calibration fitting into its mate.
  28. Install the read-out module by following the mounting instructions in the instruction manual for the single module model.
  29. Refer to the instruction manual for wiring details.

## **Appendix B**

### **Definitions of Terms**

The following defines terminology used in this manual that may be unfamiliar to some users:

**Zero:** A zero (0) indication on the meter display indicates an ambient air present, or no hazardous gases present.

**Zeroing:** The process of defining a zero condition on the display.

**Span:** An up-scale reading on the meter display

**Spanning:** The process of defining an up-scale reading on the display.

**SPAN Gas Value:** The gas concentration which gives the instrument an up-scale or full-scale value. This value is printed on the cylinder containing the gas.

**Exhaust Gas:** The gas after it passes the sensor.

**Flow Rate:** The speed of the gas in the sample line.

**Pump:** An electromechanical device which moves the gas sample to the Toxgard II instrument.

**Upscale:** Instrument alarms on gas concentrations greater than or equal to the alarm value.

**Downscale:** Instrument alarms on gas concentrations less than or equal to alarm value.

**Non-latching:** Alarms reset automatically when alarm condition clears.

**Latching:** Alarm relays and indicator lamps remain active (after alarm condition clears) until they are manually de-activated by pressing the HORN/ALARM ACKNOWLEDGE button.