



**Model 4400
In Stream Hydrogen Sulfide Monitor**

APPLICABILITY & EFFECTIVITY

Effective for all Model 4400 systems manufactured after May 1, 1997.

Instruction Manual Part Number T14004
Rev. A

Model 4400

**IN STREAM HYDROGEN
SULFIDE MONITOR**

TABLE OF CONTENTS

	PAGE
1. PRODUCT DESCRIPTION	
1.1. General	1
1.2. Description	1
1.2.1. Sample Flow Controller	1
1.2.2. Sensor & Transmitter	1
2. CAUTIONS WARNINGS AND RECOMMENDATIONS	
2.1. Introduction	2
2.2. Cautions	2
2.2.1. Wiring	2
2.2.2. Natural Gas Hazards	2
2.2.3. Hydrogen Sulfide Hazards	2
2.2.4. Input Pressure Regulation	2
2.3. Preventative Maintenance	2
3. INSTALLATION	
3.1. Site Selection	3
3.2. Monitor Installation	3
3.3. Controller Installation	3
3.4. Interface wiring	3
3.5. Sample Line Connection	3
4. OPERATION AND CALIBRATION	
4.1. Operation	4
4.1.1. Power-up	4
4.1.2. Flow Control	4
4.2. Calibration	4
4.2.1. Preparation	4
4.2.2. Sensor Cycle	4
4.2.3. Calibration Procedure (Model 4001 Controller)	5
4.2.4. Calibration Procedure (Model 5100-99-IT)	6
4.3. Maintenance	7
4.3.1. Coalescing Filter	7
4.3.2. Sample Harness	7
4.3.3. Sensor Replacement	7
5. SPECIFICATIONS	8
6. LIMITED WARRANTY	8

1. Product Description

1.1 General

The Model 4400 In-Stream Hydrogen Sulfide Analyzer (Figure 1.1) is a fixed installation system designed for continuous analysis of a natural gas sample for the presence of 0-100 ppm levels of Hydrogen Sulfide. The system is used to insure that Hydrogen Sulfide levels in natural gas collection lines remain below acceptable levels. It is intended for continuous monitoring prior to the addition of odorants to the gas.

1.2 Definition

The Model 4400-10 is a monitor which is used in conjunction with a controller. The following are the components of the monitor.

1.2.1 Sample Flow Control (Figure 1.2)

The Model 4400 receives a low pressure natural gas sample, analyzes the sample for the presence of Hydrogen Sulfide and vents the sample. A flow controller delivers a constant flow to the sensor and allows for easy calibration and maintenance.

The sample flow portion of the Model 4400 includes:

- Sample line input
- Sample Control Valve
- Coalescing Filter

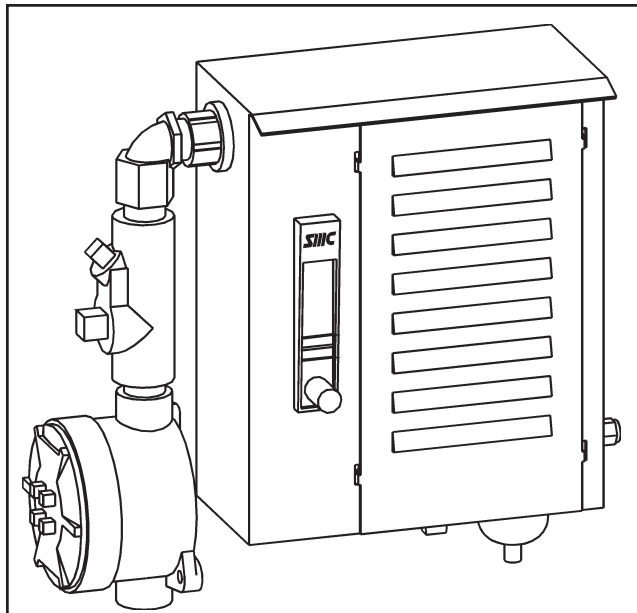


Figure 1.1
Model 4400 In-Stream H₂S Analyzer

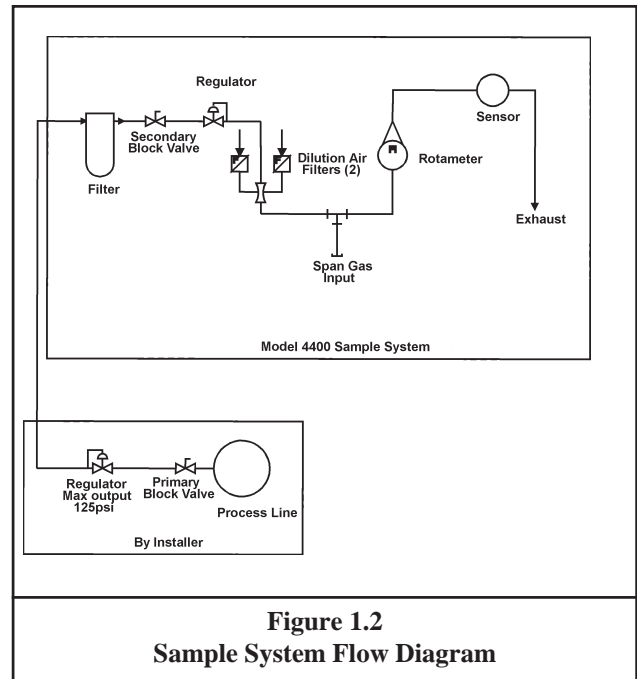


Figure 1.2
Sample System Flow Diagram

- Calibration Gas Input port
- Sample Flow Control rotameter
- System Flow Harness
- Sample Flow Regulation
- Sensor Manifold

1.2.2 Sensor & Transmitter

The sensor and transmitter includes:

- Transmitter mounting base
- Fully encapsulated transmitter electronics
- Sensor assembly

The sensor electronics provides a 4-20 mA current loop which is proportional to the full scale sensitivity of the sensor (0-100 ppm). This signal can interface to any standard industrial controller, including the 5100-99-IT Display/Transmitter Modules, Models 4001 or 4011 Single Channel Controllers or Sentry Controller available from Sierra Monitor Corporation. Integral features of the sensor electronics are:

- Electrical fault indication (0 mA) to controller.
- Sensor protective circuitry to maintain operational readiness of sensor during power "off" periods.

2. Cautions Warnings and Recommendations

2.1 Introduction

Although the system is designed and constructed for installation and operation in industrial applications including “hostile” environments, caution should be taken to insure that the installation is made in compliance with this instruction manual and that certain procedures and conditions are avoided.

This chapter discusses the necessary cautions. Read the entire chapter prior to installation of the equipment.

2.2 Cautions

2.2.1 Wiring

All wiring must be installed in compliance with NEC practices for working in a Class I, Division 2 environment. Proper grounding of supply wiring, appropriate conduit and fittings and explosion proof sealing must be used.

Avoid installing the system where it will be unnecessarily exposed to wind, dust, water (esp. direct hose down), shock, or vibration. Observe temperature range limitations.

The sample flow controller should not be painted. Paint may contain compounds which will contaminate the sensor. Paint will also cause clogging of the breathing surface of the sensor. The flow controller should be tagged “DO NOT PAINT”.

2.2.2 Natural Gas Hazards

Natural gas is VERY COMBUSTIBLE! The lower explosive limit is 5.0% by volume and the gas in the sample stream is 100% by volume. Natural gas is lighter than air, the specific gravity is 0.665 (air specific gravity is 1.0). Extreme caution should be taken to avoid accumulation of natural gas in any containment where an explosive mixing with air can occur, also to avoid generating any ignition source. Area classification and declassification regulations should be strictly enforced including the use of portable combustible gas detection instruments prior to opening the explosion proof enclosures.

2.2.3 Hydrogen Sulfide Hazards

This system is designed to operate in a natural gas

stream and to monitor for the presence of low concentrations of Hydrogen Sulfide. Standard safety practices applicable to Hydrogen Sulfide hazards should be observed due to the possibility of the presence of high levels of toxic gas in the stream or in the work vicinity.

2.2.4 Input Pressure Regulation

The system is designed to accept low sample stream pressures only and reliable pressure regulation must be provided in-line prior to the delivery of the sample to the analyzer flow regulator.

NOTE: The regulated sample pressure delivered to the sampling system must be maintained between 15 and 100 psi to insure proper functioning of the filter and flow control systems. The sampling system must be installed vertically and insulated against continuous vibration to insure proper operation.

2.3 Preventative Maintenance (See Section 4.2)

In addition to calibration periodic preventative maintenance is required as follows:

1. The collection bulb on the coalescing filter must be bled at any time liquid builds to the bottom of the filter element.
2. The coalescing filter element must be replaced when it is discolored.
3. The replaceable flow system harness must be replaced when it is sufficiently dirty to restrict sample flow. This will occur when the clear tubing in the harness has discolored so that it is no longer transparent.
4. Inspect the sample flow monitor visually to determine if dust or dirt build up needs to be removed. This cleaning should be done with dry instruments such as compressed air, cloth wipes or whisk broom.
5. Insure that threads are kept clean and properly lubricated.

3. Installation

3.1 Site Selection

Select a location for the monitor which is remote from the controller to insure that leaked natural gas is fully ventilated and is not accumulated in explosive concentrations. Other considerations include:

- Keep sample exhaust away from structures which may cause gas accumulation.
- Wiring must be installed between the monitor and the controller following site classification regulations.
- Tubing must be installed between the monitor and the sample location following site classification and safety regulations.

3.2 Monitor Installation

Install a mounting post following the dimensional instructions in figure 3-1.

Install the monitor by passing the four mounting studs through the holes on the “H” bracket and secure with the supplied washers and nuts.

3.3 Controller Installation

The controller is supplied in an enclosure appropriate to the application based on location classification. The mounting location should be selected to provide maximum protection from weather and direct sunlight. Preferably the controller will be inside a secured structure.

Mount the controller on a vertical surface at eye level insuring sufficient clear space to install conduit into the downward facing conduit hubs. Also allow for clear space to open the door.

3.4 Interface wiring

Install a two conductor shielded cable (18 AWG) between the controller and the monitor. At the monitor conduit connect the two conductors to “P” power and “S” signal. Connect the drain wire to terminal “G” ground.

At the controller connect the “P” conductor to channel power, “S” conductor to channel signal and the shield to chassis ground.

Follow controller instruction manual for power and alarm connections.

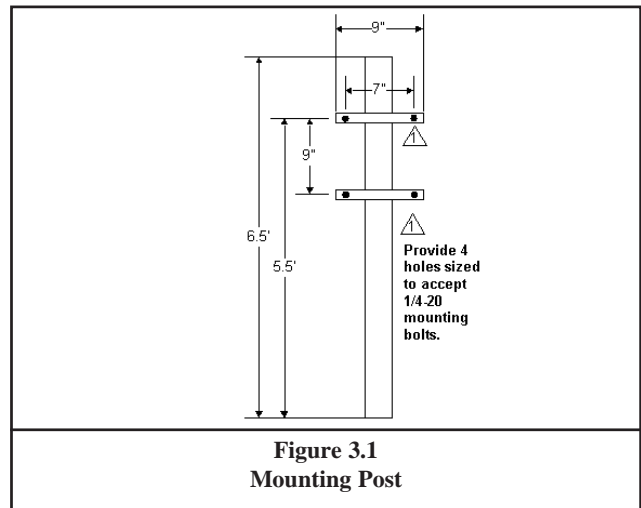


Figure 3.1
Mounting Post

3.5 Sample Line Connection

To provide for correct sample handling:

1. At the sample source, provide pressure regulation such that the sample line can never exceed 100 psi.
2. From the sample source provide a 1/4” OD stainless steel tube for connection to the sample input port on the right hand side of the monitor. See Figure 3-2.
3. Open the monitor by lifting and removing the louvered cover. Locate the exhaust tubing which is coiled inside the monitor. Uncoil the tube and route it to a convenient free air exhaust location. Cut the tube to the shortest functional length.
4. Remove the black protective cap from the bottom of the coalescing filter.

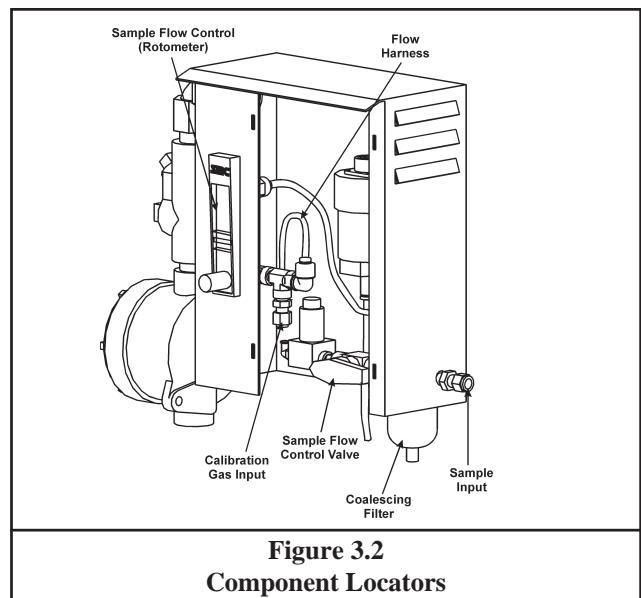


Figure 3.2
Component Locators

4. Operation and Calibration

4.1 Operation

4.1.1 Power-up

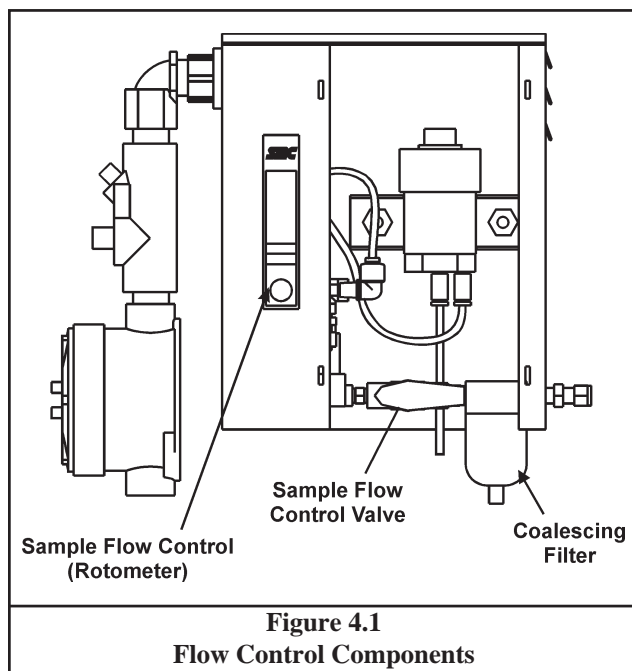
After installation has been completed in compliance with section 3, provide primary power to the controller. Allow time for the sensor in the monitor to stabilize until a zero reading is established.

4.1.2 Flow Control

Begin sample flow to the monitor by:

1. Open the monitor cover and place the sample flow control valve (Figure 4-1) in the off (vertical) position.
2. Turn the rotameter to full off by closing the knob finger tight clockwise.
3. At the sample location confirm that pressure is regulated to less than 100 psi and open the valve to the sample line.
4. Open the sample control valve.
5. Open the sample flow control (rotameter) slowly until the indicator is at 0.5 SCFH.

The system is now in run mode. Allow one hour for stabilization before logging data or activating alarms.



4.2 Calibration

The Model 4400 requires calibration using Hydrogen Sulfide span gas, via a permeation tube, every 2 weeks. The span gas should be approximately 15 ppm using the stream as the balance and should be delivered at a flow rate of 0.5 SCFH

4.2.1 Preparation

1. Remove the monitor cover.
2. Clear any liquid accumulation in the coalescing filter by pressing the actuator at the bottom of the bulb. Visually inspect the filter element and replace if necessary. (To replace the element the sample control valve must be shut off).
3. Turn off the gas flow at sample control valve.
4. Inspect the clear tubing lines on the flow system harness to determine if there is any oiling or other contamination in the line. If the line is contaminated an orifice in the harness may be blocked and the harness must be replaced.
5. To remove the harness (see Figure 3-2) twist the white leuc fitting located immediately behind the sample flow control counter-clockwise 1/2 turn and unseat it from the connecting port. Remove the other end of the harness from the sensor manifold. To disconnect from the manifold, push the black ring upward and simultaneously pull the tubing downward.
6. To install the replacement harness slide the open end into the fitting on the bottom of the manifold and connect the white leuc fitting to the back of the rotameter.

4.2.2 Sensor Cycle

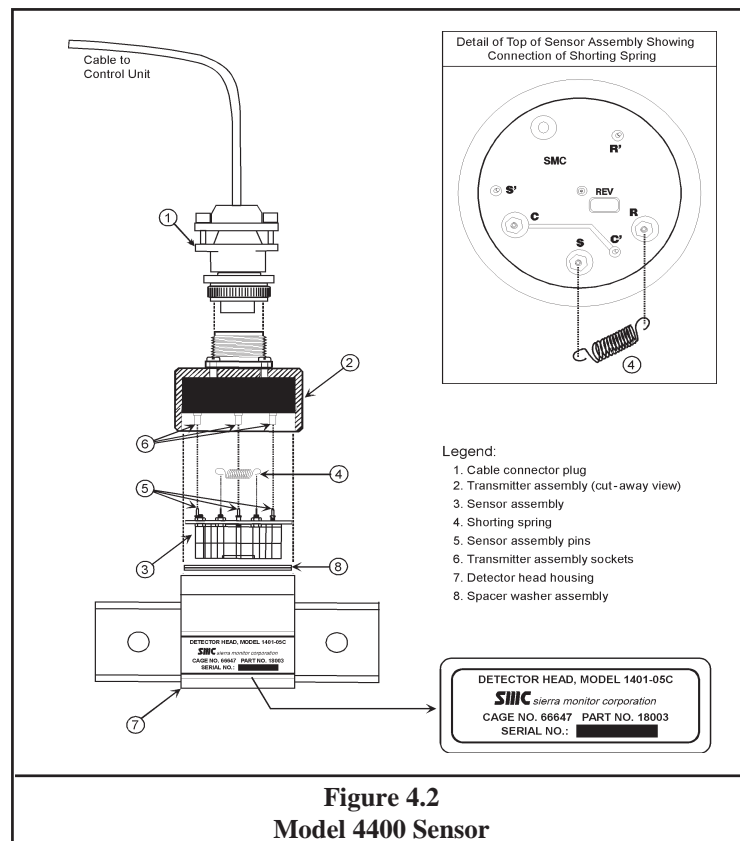
The Model 4400 monitor is supplied with one sensor installed and one spare. At each calibration the sensors should be cycled to allow one sensor to refresh while the other is in service. To cycle the sensors:

1. Disable alarm and shut down devices at the controller
2. Shut off sample flow using the sample control valve.

3. Unscrew the wiring connector on the top of the sensor assembly. (Figure 4.2)
 4. Remove the sensor and sensor transmitter head from its base, but turning the knurled head counter-clockwise.
 5. Unplug the sensor from the transmitter head.
 6. Move the shorting spring from the refreshed sensor to the one which has been removed from service (connect the spring to terminals “R” and “S”).
 7. Plug the refreshed sensor into the transmitter head and return it to the base. Insure that the transmitter is screwed all the way down onto the base.
 8. Re-attach the wiring connector.
1. The sample flow which was turned off for sensor cycling should remain off while the zero is adjusted.
 2. Refer to figure 2 of the Model 4001 controller manual and find the location of the “zero display adjust” potentiometer. Adjust the “zero” potentiometer on the sensor electronics (round enclosure) until the display on the controller reads zero (“00.2”).
 3. Span gas is to be supplied via a permeation tube. Calculate the concentration for the tube using current temperature and a flow rate of 0.5 SCFH.
 4. Remove the cap on the Calibration Gas Input (Figure 3-2).
 5. Connect the permeation tube to the Calibration Gas Input.
 6. Turn the flow sample control valve on.
 7. Allow the span gas to run until the controller reading is stable (approximately 5 minutes).

4.2.3 Calibration Procedure (Model 4001 Controller)

The following instructions assume that the controller is a Sierra Monitor Model 4001. If a different controller is used, modify this procedure to conform to the controller instructions.



8. Adjust the controller “gain” potentiometer until the display on the controller indicates the concentration of the span gas.
9. Turn off the flow at the sample control valve.
10. Remove the calibration gas and recap the calibration gas input.
11. Turn on the flow at the sample control valve.

4.2.4 Calibration Procedure - Model 5100-99-IT

The following instructions are applicable when using the Model 5100-99-IT Display/Transmitter with the Model 4400. Refer to the Model 5100-99-IT Instruction Manual for further details.

The procedures requires that the menu "keys" be activated using the magnet stick. Each key pressed steps through the process of setting the zero value for clean air and then setting the span value.

At each of these steps, apply calibration gas of the value corresponding to the setting accepted on the sensor module display.

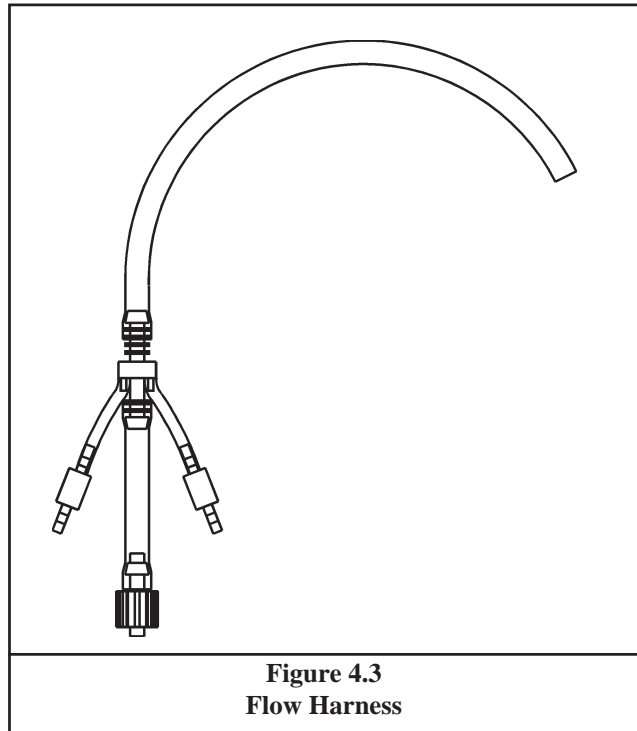


Figure 4.3
Flow Harness

Sensor Exposure to Gas

Calibration gas must be delivered to the sensor using the flow rate and duration listed in below:

Model	Gas	Flow	Period
5100-99-IT	Hydrogen Sulfide	300 cc/min	Until Stable (minimum 2 minutes)

Key	Function	Display	Description	Reference
		XXXPPM	Default Display	
M □ □	Mode	ALMRSET:	Mode Function - Alarm Reset	
M □ □	Mode	CALIB:--	Mode Function - Calibrate	
M □ □	Enter	CAL-0PPM-	Banner: Apply zero gas, enter <E> when done <i>Operation: Confirm area clear of gas, or apply zero air to sensor.</i>	
M □ □	Enter	ACK	Zero gas setting acknowledged	
		10PPM-SP	Banner: Select span, enter <E> to calibrate sensor	Sub A
M □ □	Enter	C 4 PPM	Banner: Apply span gas, then enter <E> to calibrate gas sensor	Sub B
		C 4 PPM	<i>Operation: Apply calibration gas.</i>	
		CXXXPPM	<i>Operation: As gas is applied the reading will increase - wait 3 minutes</i>	
M □ □	Enter	CAL-OK	Calibration Passed - now remove gas	
		WAIT-300	<i>Operation: Five minute time out before sensor is returned to service.</i>	
Sub-Routines				
		10PPM-SP	Banner: Select span, enter <E> when done	Sub A
M □ □	Up	25PPM-SP	<i>Operation: Change Span Gas Value to 25PPM</i>	
M □ □	Up	Adj-SPAN	<i>Operation: User adjustable value</i>	
M □ □	Enter	25PPM-SP	<i>Operation: Ready for user adjustment</i>	
M □ □	Enter	C 25PPM	Banner: Apply 25PPM gas, then enter <E> to calibrate gas sensor	Sub B
		C 25PPM	<i>Operation: Apply calibration gas.</i>	
M □ □	Enter	CAL-FAIL	<i>Operation: No calibration gas applied, or sensor did not respond correctly.</i>	
		WAIT-300	<i>Operation: Five minute time out before sensor is returned to service.</i>	
M □ □	Mode	(Any)	<i>Operation: Hold magnet over Mode Switch for ten seconds to abort calibration</i>	Sub C
			Banner: Calibration Aborted	
		XXXPPM	Default Display	
Table 5-1 Calibration				

4.3 Maintenance

4.3.1 Coalescing Filter

To replace the filter element:

Remove the monitor cover.

1. Clear any liquid accumulation in the coalescing filter by pressing the actuator at the bottom of the bulb. Visually inspect the filter element and replace if necessary. (To replace the element the sample control valve must be shut off.)
2. Turn off the gas flow at sample control valve.
3. Unthread the transparent bulb and lift out the old filter.
4. Place a new filter in the bulb and return it to the filter assembly.
5. Turn on the gas flow at the sample control valve.

4.3.2 Flow Harness (Figure 4.3)

The flow harness must be inspected at every maintenance or calibration interval and should be replaced following the instructions in 4.2.1.

4.3.3 Sensor Replacement

The sensor is to be replaced when it is no longer possible to adjust the display readings correctly during calibration or when the electrical output becomes “noisy” causing erroneous or fluctuating readings which are observed either on the display or the chart recorder.

The Hydrogen Sulfide sensor life will vary depending upon average H₂S concentration, but in typical applications the sensor life should be approximately one year.

To replace the sensor follow the steps in section 4.2.2\

5. Specifications

Power:	24 VDC
Output:	4-20 mA = 0 - 100 ppm H ₂ S
Environmental:	
Temperature:	Operating Range 4° to 122°F (-20° to 50°C) Storage Range -40° to 122°F (-40° to 50°C)
Humidity:	0 - 95% RH
Sensor:	Hydrogen Sulfide
Range:	100 ppm
Sensor type:	Electrochemical
Sensor life:	Approximately 1 year in cycled service
Response:	< 30 seconds to 90% FS

Mechanical:

Area classification:	Class 1, Div I, Groups C, D
Enclosure:	NEMA-1 with removable cover panel
Mounting:	Installs on 9" X 7: "H" frame.
Connections:	3 position terminal strip in separate conduit
Dimensions:	9.0 x 11.0 x 4.0 inches (WxHxD) (22.9 x 27.9 x 10.2 cm)
Weight:	5 lbs (2.2 Kg)

Spare and Replacement Parts:

SPMN26105	Sensor Assembly
SPM22063	Flow Harness
SPM27064	Maintenance Kit (consists of 1 spare sensor assembly, and 2 flow harnesses)
SPM64017	Filter element

6. Limited Warranty

SIERRA MONITOR CORPORATION warrants its products to be free from defects in workmanship or material under normal use and service for two years after date of shipment. SMC will repair or replace without charge any equipment found to be defective during the warranty period. Final determination of the nature and responsibility for defective or damaged equipment will be made by SMC personnel.

All warranties hereunder are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without SMC approval or which have been subjected to accident, improper maintenance, installation or application, or on which original identification marks have been removed or altered. This Limited Warranty also will not apply to interconnecting cables or wires, consumables (ie. calibration gases, flos harness, filter elements, batteries, sensors), nor to any damage resulting from battery leakage.

In all cases SMC's responsibility and liability under this warranty shall be limited to the cost of the equipment. The purchaser must obtain shipping instructions for the prepaid return of any item under this warranty provision and compliance with such instruction shall be a condition of this warranty.

Except for the express warranty stated above, SMC disclaims all warranties with regard to the products sold hereunder including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of SMC for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.