

**MODEL 4101-26
HYDROGEN FLUORIDE GAS
SENSOR MODULE
4-20 mA**

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Model 4101-26
Hydrogen Fluoride Gas Sensor Module
4-20 mA

APPLICABILITY & EFFECTIVITY

This manual provides instructions for the following Sierra Monitor products:

<u>Model</u>	<u>Description</u>	<u>Range</u>
4101-26	Hydrogen Fluoride	0-10 ppm

The instructions are effective for the above models as follows:

<u>Model</u>	<u>Date</u>	<u>Serial Number</u>
4101-26	10/15/96	96NN100

Instruction Manual Part Number: T13016

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1. PRODUCT DESCRIPTION

1.1 Introduction

Model 4101-26 Hydrogen Fluoride (HF) Gas Sensor Module is a 4-20 mA transmitter designed for use in conjunction with industry standard 4-20 mA loop controllers. The 4101-26 has an effective range of 0-10 ppm. The module requires a three wire connection to a controller that provides a nominal 28 VDC. The module sources current in proportion to the gas concentration.

1.2 Application

The model 4101-26 Hydrogen Fluoride gas sensor module is intended for use in ambient monitoring applications. It is designed for fixed installation and for continuous operation.

Optional fittings and adapters can be supplied by Sierra Monitor to provide continuous sample delivery to the sensor module.

1.3 Configuration

The gas monitor is comprised of a NEMA-7 enclosure which contains the transmitter electronics and a gas sensor which is installed in one of the two 3/4" conduit hubs.

1. Electronics

When installed, the transmitter electronics will be connected to a power supply and control device via three wire cable.

The electronics provide a 4-20 mA current loop which is proportional to the full scale sensitivity of the sensor. Integral features include:

- **Power On delay to avoid nuisance alarms.**
- **Volt meter readout proportional to gas concentration.**

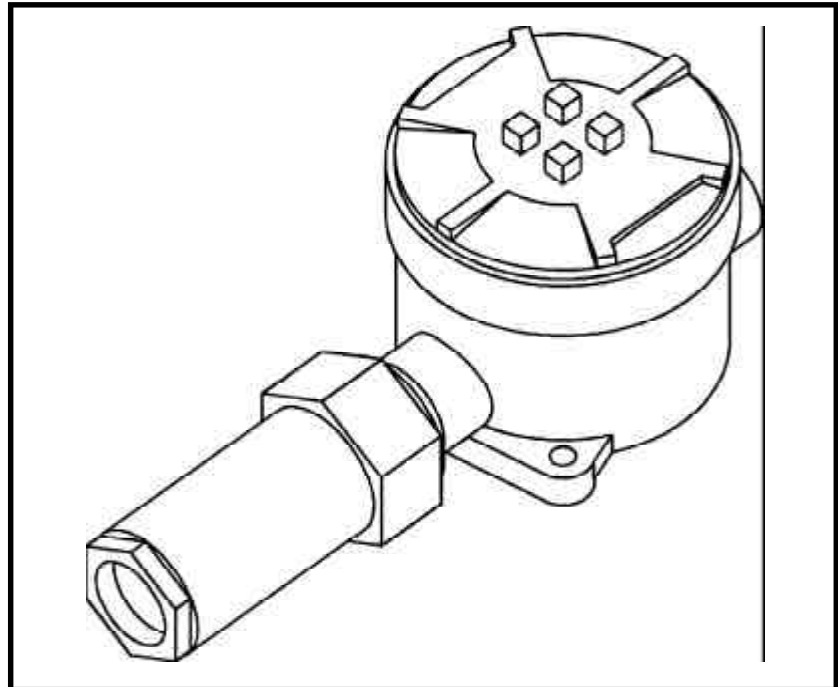


Figure 1.1
Outline View - Model 4101-26 Hydrogen Fluoride Gas Sensor Module

- **Visual indicator for fault.**
- **Electrical fault indication (0 mA) to controller.**

The transmitter electronics assembly includes a printed circuit assembly and a cover plate which contains volt meter test points, indicator LED's and access to adjusting potentiometers.

2. Sensor

The gas sensor is an electrochemical type using a membrane barrier. The electrochemical sensor is enclosed in a threaded housing and is plugged into a signal conditioning card located in the threaded housing. This configuration allows for easy field replacement of the sensor cell.

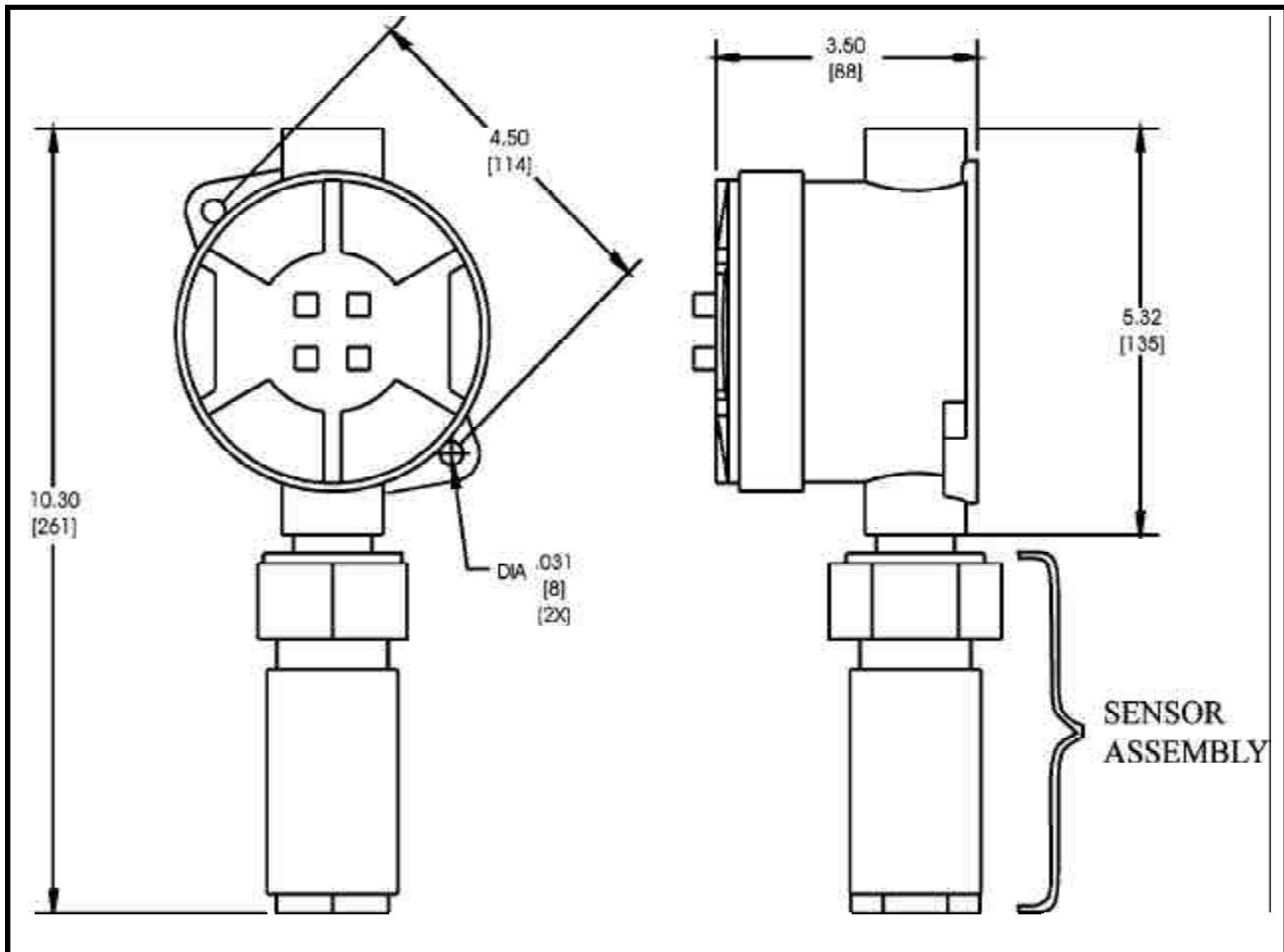


Figure 1.2
Model 4101-26 Outline and Dimensions

2. CAUTIONS WARNINGS & RECOMMENDATIONS

2.1 Introduction

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

READ AND UNDERSTAND THIS INSTRUCTION MANUAL BEFORE OPERATING OR SERVICING THIS EQUIPMENT.

2.2 Wiring

Electro magnetic and radio frequency interference to the analog communication between the sensor and the controller may occur. The manufacturer recommends that extra caution be taken where the installation is near any sources of these interferences.

Avoid running sensor cable close to high power cables, radio transmission lines, or cables subject to pulses of high current. Avoid running cables near large electric motors or generators.

Use shielded cable in any location which may be expected to be electrically noisy or where cable is expected to be in close contact with AC wiring. The shield should be connected at both ends (the module to the ground lug and at the controller earth ground).

The wiring should be run in either a cable tray or conduit as required by applicable code and area classification. Control wiring should not be installed in a cable tray or conduit with higher voltage and AC circuits. See Table 2.1 for recommended wire gauge.

Wiring connections at the gas sensor module are as follows:

<u>Wire#</u>	<u>Function</u>	<u>Terminal</u>
1	Power	“P”
2	Signal	“S”
3	Ground	“G”

Connect an earth ground to the ground screw provided in the base of the gas sensor module enclosure.

All splices must be via either a lug and terminal system or soldered. Improperly spliced cable can result in corrosion, resistance changes and system errors.

Wire Gauge	Maximum Length
20 AWG	2,000 Ft.
18 AWG	3,000 Ft.
16 AWG	4,000 Ft.
14 AWG	6,500 Ft.
12 AWG	9,000 Ft.

Table 2.1
Recommended Wire/Cable Gauge

NOTE: Temperature rating of cable wire insulation must be above 75°C (85°C or greater rated wiring is recommended). If cable runs through higher temperature environments, it should be specified for that environment.

2.3 Sensor Modules - General

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

Sensors may be adversely affected by prolonged exposure to certain materials. Loss of sensitivity, or corrosion, may be gradual if such materials are present in low concentrations. These materials include: Halides (compounds containing chlorine, fluorine, bromine, or iodine), silicones, acid vapors, caustic liquids or vapors.

Sensor modules must not be painted. Paint may contain compounds which will contaminate the sensor. Paint will also cause clogging of the sintered metal cup and will cause difficulties during attachment of the calibration head. The module should be tagged “DO NOT PAINT”.

2.4 Preventative Maintenance

DUST AND DIRT CONTROL: When calibration is performed the controller and sensors should be checked 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.

WIRING OR CABLE CONDITIONS: Any wiring or cables which are not conduited should be checked once a year for damage to insulation or corrosion of splice or terminal points.

3. QUICK START

3.1 Overview

The gas sensor module has been supplied factory calibrated and ready for immediate installation and operation. An installer familiar with installation and operation of gas detection products can use this section to begin immediate use of the monitor.

3.2 Wiring

Provide three conductor wiring from the power supply/control device to the sensor module location. See section 2.2 for wiring specifications.

3.3 Module Installation

The module can either be installed on the end of a 3/4" conduit, or attached to a vertical surface using the mounting flange on the enclosure. Three important warnings:

- **The installation must meet any hazardous environment codes for electrical equipment.**
- **The sensor module enclosure mounting must be far enough from any vertical surface to allow removal and replacement of the sensor assembly which is threaded into the second 3/4" conduit hub.**
- **Remove the red sensor assembly protective cap (used only during shipment to prevent damage to the membrane and end of sensor assembly) from the end of the sensor before operation.**

3.4 Wiring Connection

Terminal positions on the transmitter printed circuit assembly are labeled "P" (power), "S" (signal), "G" (ground). Make the corresponding connections to the control device/power supply. The sensor harness should remain plugged into the transmitter printed circuit assembly at "J1".

3.5 Transmitter Installation

To install the transmitter printed circuit assembly into the housing, carefully turn the face plate so that the printing is in the correct horizontal position and slide the assembly over the two stand-offs in the enclosure.

Hand tighten the two captive panel thumb screws into the stand-offs. Replace the enclosure cover prior to providing power to the transmitter

- **If the sensor transmitter is installed in a classified hazardous area, replace the threaded cover prior to providing power.**

3.6 Start-up & Operation

To begin operation of the sensor module provide 14-28 VDC from a regulated power supply. Each time the sensor module is powered up it will perform a warm-up for approximately five minutes. During this time the calibration delay LED will be "on" and the loop output will be held at 4 mA.

After the warm-up period has expired the delay LED will turn off and the loop will be released to output in the range of 4-20 mA proportional to the gas concentration.

3.7 Zero Stabilization

All electrochemical sensors require at least 30 minutes on power prior to calibration. This allows the electrode potentials to equilibrate, resulting in a stable zero signal level.

4. OPERATION

4.1 Introduction

Under normal conditions the sensor module does not require operator or technician intervention. The following are conditions under which the module requires attention:

- Routine periodic calibration.
- Calibration after a high gas alarm.
- Electrolyte replacement on a planned schedule (recommended every six months) or when a low sensor output occurs (less than 4 mA).
- Periodic cleaning as necessary.
- Unanticipated maintenance.

4.2 Operating Characteristics

1. Signal Value

During normal operation the current loop of the sensor module and the controller will be between 4 mA indicating no presence of gas, and 20 mA indicating that the full concentration of gas is present. The signal value is proportional to the concentration of gas present.

2. Loop Signal Delay Feature

When power is first applied to the module the output signal is clamped to 4 mA by internal circuitry on the board. This allows the sensor to stabilize after power has been applied to the module. This delay is visually indicated by an LED (Labeled CAL DELAY) on the transmitter cover plate (Figure 4.1). This delay will last approximately 5 minutes after which time the electronics removes the 4 mA hold.

During calibration it may be necessary to avoid changing the loop current output from its normal 4 mA condition. This can be accomplished by

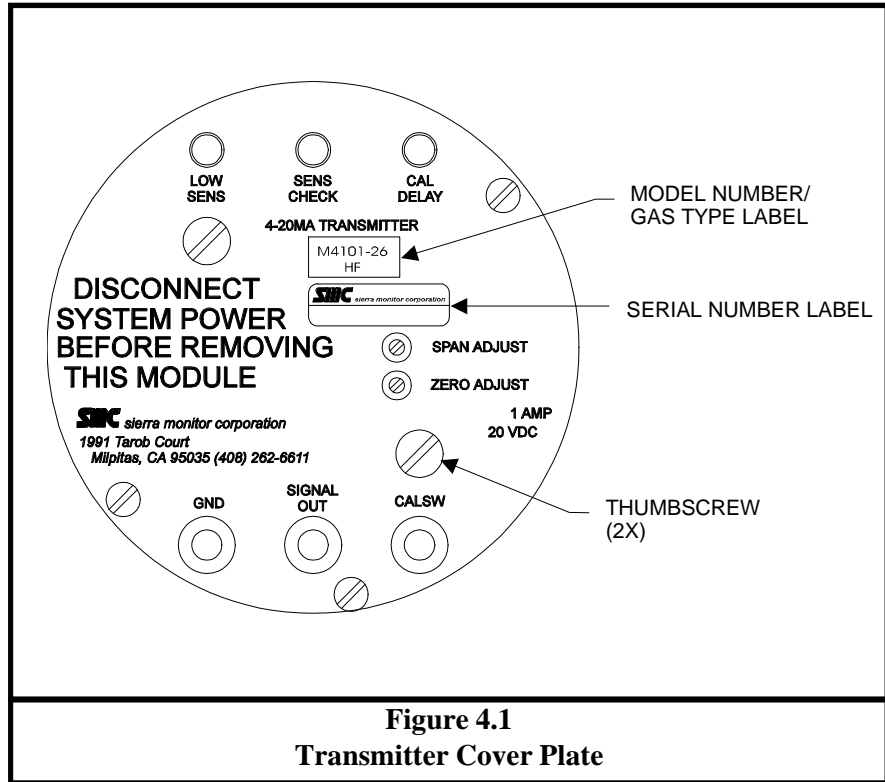


Figure 4.1
Transmitter Cover Plate

jumping the calibration test jack “CALSW” on the module plate to the “GND” test jack. This action will cause the output to be clamped at 4 mA.

The Calibration Delay will remain on for 4 to 6 minutes after the calibration head or the jumper have been removed.

3. Low Sensitivity

The module has been designed to automatically perform a Low Sensitivity Check when the jumper has been removed from the “CALSW” and “GND” test jacks. This action will cause the “SENS CHECK” LED and “CAL DELAY” LED to turn on. This check verifies that the output of the sensor has not deteriorated to a level that may cause its output to dramatically decrease over a short period of time. If the output of the sensor is below the factory set Low Level Threshold then the “LOW SENS” LED will turn ON and the module output current will drop to 0 mA. The “LOW SENS” LED indicates that the sensor should be replaced.

5. CALIBRATION

5.1 Frequency of Calibration

Sierra Monitor recommends that the gas sensor module be calibrated every 90 days.

5.2 Calibration Process

The output signal of the gas sensor is calibrated by either using a span mixture containing a known concentration of the gas of interest, or using an equivalent calibration gas. If the user has access to Hydrogen Fluoride calibration gas it is recommended that a concentration between 5 and 10 ppm be used for calibration. If the user does not have access to HF calibration gas, an equivalent calibration gas, Chlorine, can be used. The Model 1250-03 Gas Calibrator and the 1260-06 Chlorine (5 ppm) Calibration Gas from Sierra Monitor can be used to calibrate the Model 4101-26 Hydrogen Fluoride Gas Sensor Module.
 $5 \text{ ppm Cl}_2 = 6 \text{ ppm HF}$.

Calibration requires application of the span gas to the sensor and adjustment of the SPAN potentiometer to make the module signal output equivalent to the concentration of the sample gas.

5.3 Equipment Required

The following tools and equipment will be required for calibration:

- Jewelers Screwdriver
- Calibration Adapter (Model 5358-01)
- Gas Calibrator (Model 1250-03) and Chlorine Calibration Gas (1260-06), or Hydrogen Fluoride Calibration Gas.

5.4 Calibration Procedure

To begin calibration remove the cover from the Module enclosure, and proceed according to the instructions below:

1. Apply Calibration gas at a flow rate of 350cc/min if using Chlorine calibration gas (use 500 cc/min if using HF calibration gas).
2. Allow 3 minutes before making any adjustments.
3. If necessary adjust the SPAN pot so that the correct concentration is displayed at the controller.
4. Remove the calibration gas, wait 5 minutes and verify that the concentration displayed on the controller goes to 0 ppm. If not adjust the "ZERO" pot to obtain the correct reading.

6. SERVICE

6.1 Sensor Module Configuration

The gas sensor module is comprised of the following sub assemblies (Figure 6.1):

4101-26	Gas Sensor Module
-SPL21767	Enclosure
-SPM27049	Transmitter Assy.
-4201-26	Sensor Assy.

Warning: Prior to removal of the transmitter assembly remove system power at the controller or other power source.

6.2 Enclosure Replacement

The enclosure should be replaced if the lid threads or conduit threads have been damaged, or if the enclosure has corroded sufficiently that it no longer meets the required NEMA classification.

To replace the enclosure follow the transmitter (Sec. 6.3) and sensor assembly (Sec 6.4) removal instructions, remove the damaged enclosure from it's conduit or wall mounting, install a new enclosure and continue the transmitter and sensor assembly replacement instructions.

6.3 Transmitter Replacement

The transmitter assembly should be replaced when it is determined that it is unreliable, noisy or cannot be adjusted for calibration. This may occur due to age, corrosion or failed components.

To replace the transmitter assembly:

1. Remove the cover of the main enclosure.
2. Unscrew the two thumb screws in the top of the cover plate, lift the assembly and rotate 90° to relieve the wiring service loop.
3. Unplug the sensor connector from the transmitter.
4. Remove the three wires from the P,S,G terminals.
5. Reverse the preceding steps to install the new transmitter.
6. Restore power and allow a minimum of 30 minutes for stabilization before re-calibration.

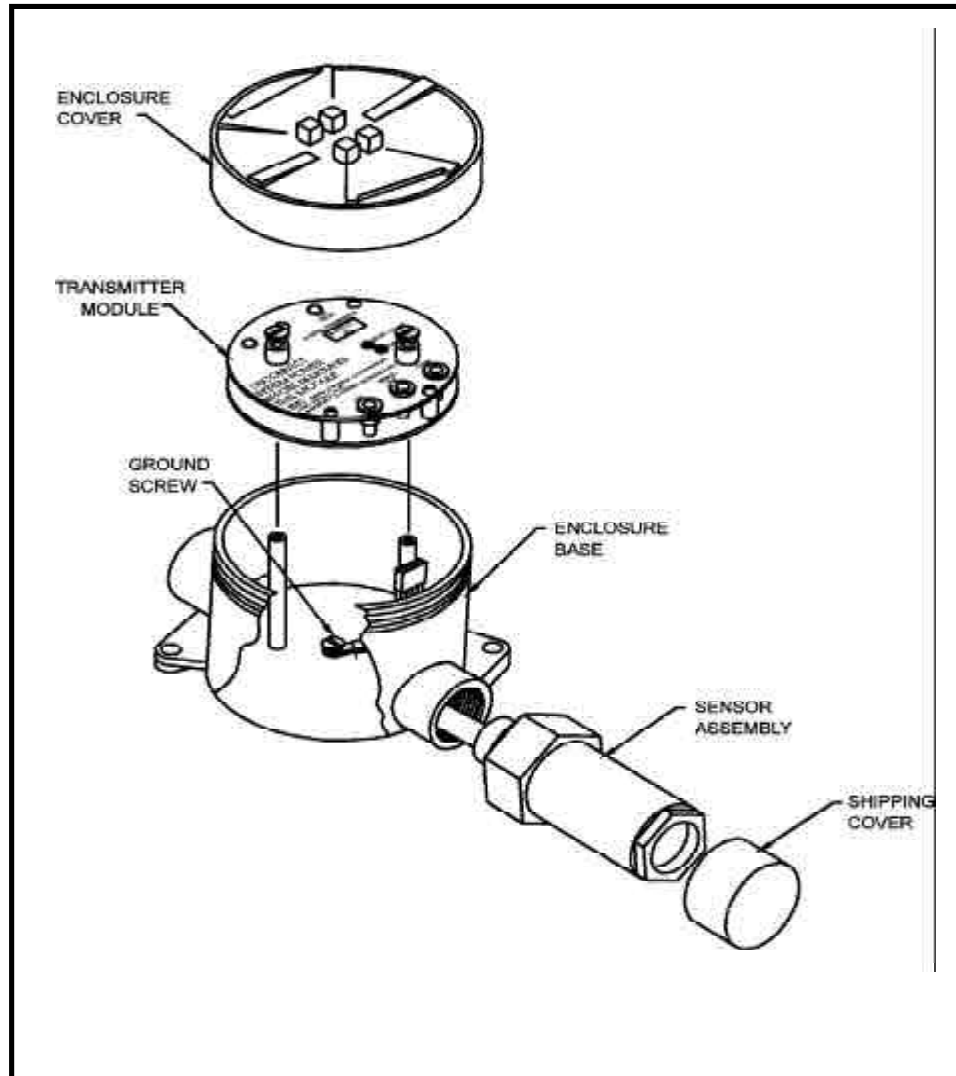


Figure 6.1
Gas Sensor Module - Exploded View

6.4 Electrolyte/Membrane Replacement (See Fig. 6.2)

The electrolyte needs to be replaced at least every six months, or if there is evidence of low sensor output. The membrane should be replaced at the same time that the electrolyte is replaced.

1. Equipment Required

- **Electrolyte Recharge Kit** (SPX27061) consisting of the electrolyte, package of 5 membranes, one (1) O-Ring and alcohol wipes to clean the electrode.
- Tweezers to aid in removing and replacing the membrane

2. Preparation

- a. Transfer the necessary electrolyte into a plastic wash bottle.
- b. Confirm that system power has been removed.
- c. Remove the transmitter electronics board from the main housing and unplug the sensor harness from the transmitter electronics.
- d. Unscrew the sensor assembly from the bottom of the enclosure.
- e. Remove the assembly cover from the sensor assembly.

CAUTION: Only remove the sensor cover from the assembly, **DO NOT** attempt to unscrew the sensor from the mounting assembly or you could damage the wiring.

3. Electrolyte Replacement (See Fig. 6.3)

- a. Invert the sensor assembly so that the membrane is upward.
- b. Insert the sensor assembly in a clamp, if available, and unscrew the box nut counterclockwise, and take out the hold-down ring, membrane, O-Ring, and washer. Then pour out the old electrolyte into a beaker for disposal.

CAUTION: Avoid contact of the electrolyte with skin, eyes and clothing. In case of contact wash immediately - rubber gloves and safety glasses are recommended.

- c. Hold the sensor assembly with the sensing electrode up. Close the pressure compensation port with a tissue. Pour approximately 10cc of fresh electrolyte from the wash bottle into the sensor, and rinse the inside of the sensor. Empty the electrolyte into the beaker.

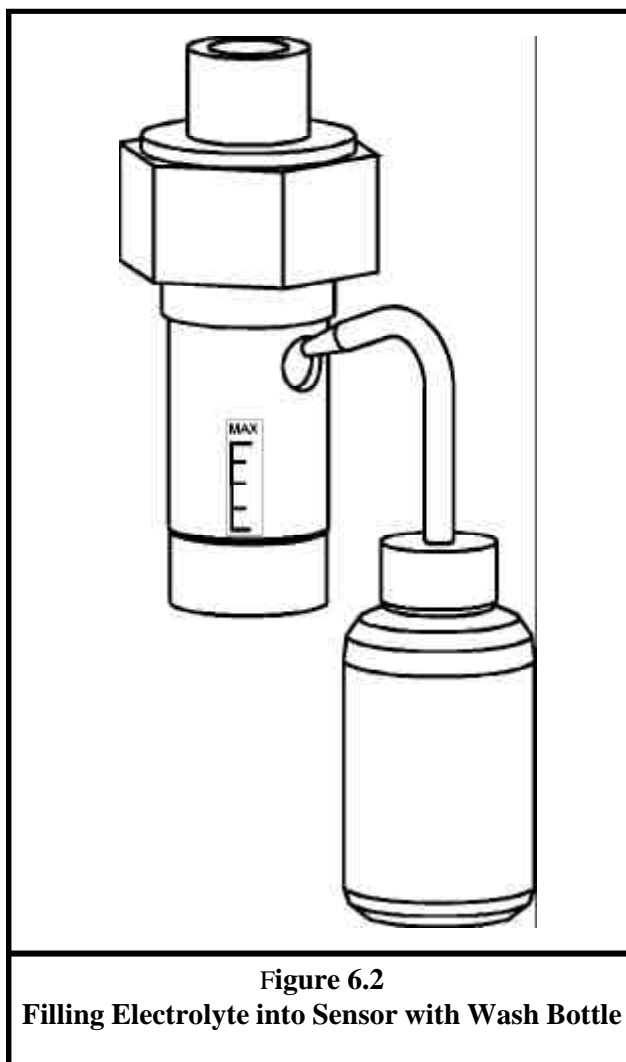


Figure 6.2
Filling Electrolyte into Sensor with Wash Bottle

- d. Clean the electrode with the alcohol wipes included in the electrolyte replacement kit. When dirt is found inside the sensor assembly, wash the dirt off with electrolyte.
- e. Place the old washer back over the sensor and place the O-ring on top of the washer. Then transfer one drop of electrolyte from the plastic wash bottle to the exposed electrode surface.
- f. Place a **new** membrane into the hold-down ring and carefully place the plastic hold-down ring on top of the sensor body with the ring ears in the slots of the sensor body. Then fasten the sensor cover over the assembly.

CAUTION: Never touch the membrane with your hands. Use rubber gloves or tweezers.

- g. Invert the sensor so that the membrane is down. If this is the first time that electrolyte has been replaced, there should be a round Mili Seal covering the pressure compensation screw. This Mili-Seal prevented loss of electrolyte during shipment. Remove and discard the round Mili Seal and remove the screw to expose the electrolyte supply port.
- h. Transfer electrolyte from the plastic wash bottle into the electrolyte supply port (see Fig. 6.2) until the level is at the maximum level line on the side of the sensor body.
- i. Replace the pressure compensation screw into the electrolyte supply port.
- j. Replace the sensor housing cover.
- k. Install the sensor assembly into the enclosure hub and tighten firmly.
- l. Reconnect the sensor harness to the transmitter, carefully install the transmitter into the housing and restore system power.
- m. Recalibrate the transmitter following the instructions in Section 5.

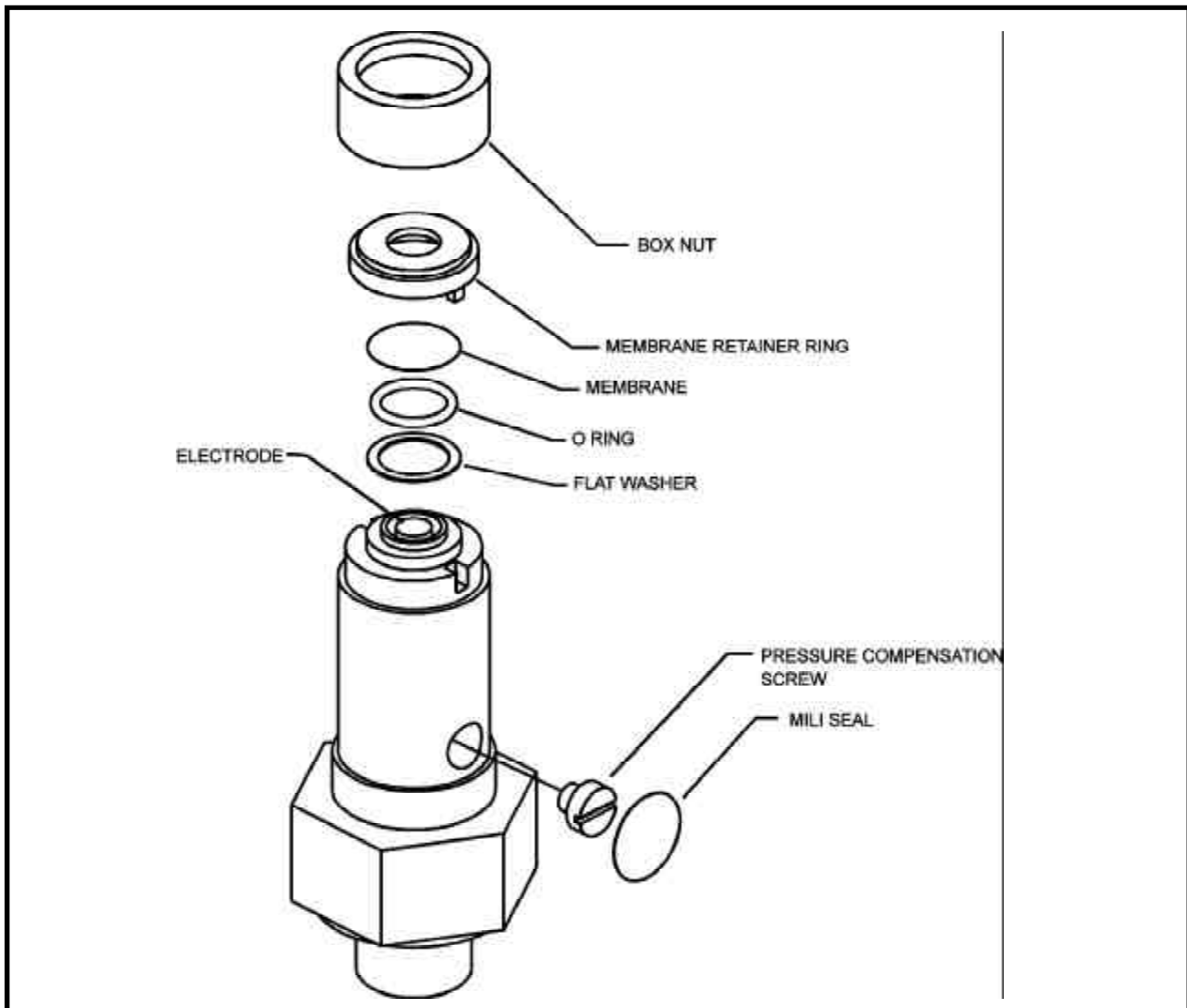


Figure 6.3
Sensor Assembly - Exploded View

7. INSTALLATION

7.1 Sensor Locations

The gas sensor module is a diffusion type sensor which should be located close to either the expected source or destination of the gas hazard. The specific gravity of Hydrogen Fluoride is 1.27 making it heavier than air. Thus the gas sensor module should be mounted at elevations higher than the expected source.

After optimum locations are determined based on the above recommendations, consideration should be given to placing the sensors in locations which are accessible for calibration service. Slight adjustments to the location of the sensor may have little impact on effectivity but major effect on accessibility.

7.2 Sensor Mounting

Where possible sensor modules should be installed with the sensor facing vertically down. The lid of the sensor module should face out for easy access.

Sensors may be mounted directly onto the end of a vertical conduit, or bracketed to a vertical surface using the two mounting flanges. Insure

that the body of the enclosure is at least 1" from the wall so that the sensor assembly can be rotated for removal and replacement. See Figure 7.1 for installation configurations.

7.3 Wiring

The gas sensor module will be installed in conjunction with a single or multi-channel loop controller or a distributed control system. In each case, three wires will be required to run between the control device and the gas sensor module. See Table 2.1 for recommended minimum wire gauge. Use shielded cable in any location which may be expected to be electrically noisy or where cable is expected to be in close contact with AC wiring.

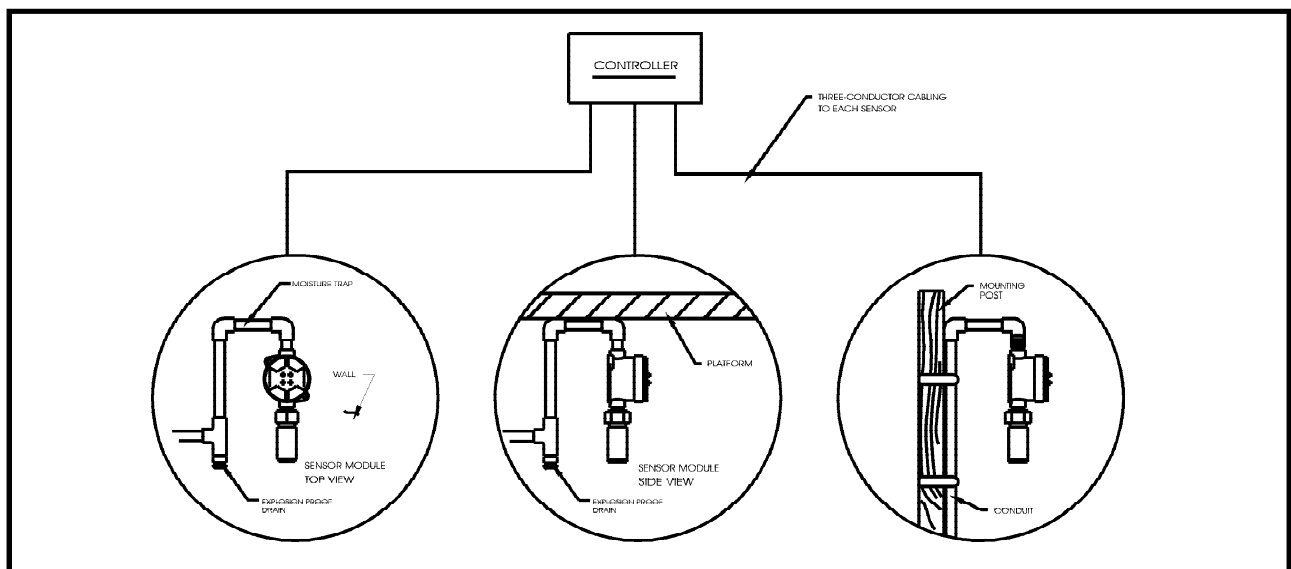
7.4 Explosion Proof Installation

Where area classification requires explosion proof (NEMA-7) installation a sealing fitting will be required immediately above the gas sensor module enclosure.

7.5 Power Supply

The power supplied by the controlling device or an external power supply must meet the following specifications:

Voltage: 14-28 VDC
 Current: 80 mA



**Figure 7.1
 Gas Sensor Module Installation**

8. SPECIFICATIONS

SENSOR

TYPE:	Electrochemical - membrane barrier type
RANGE:	0 - 10 PPM Hydrogen Fluoride (HF)
RESPONSE:	90% in less than 30 seconds
RESOLUTION:	10% Full Scale
TYPICAL LIFE:	Five years in normal service (electrolyte needs to be changed every 6 months)
OPERATING TEMPERATURE:	14°F to 113°F (-10°C to 45°C)
HUMIDITY:	20% RH to 95%RH
PRESSURE:	± 10%

ELECTRICAL DATA

WIRING:	3 wire non-isolated
INPUT VOLTAGE:	14 - 30 VDC
INPUT CURRENT:	40 mA at 28 VDC
INPUT POWER:	1.4 W
OUTPUT RANGE:	4 mA = 0%, 20 mA = 10 ppm
SIGNAL OUTPUT-TROUBLE:	0 mA
MAXIMUM LOOP RESISTANCE:	800 Ohms (max @ 21VDC)

CALIBRATION

CALIBRATION FREQUENCY:	Every 90 days
ADJUSTMENTS:	Zero and Span

CONSTRUCTION

ELECTRICAL CLASS:	Division 1, Class I, Groups C&D
MOUNTING:	Conduit
PHYSICAL:	8.8" x 4" x 4.2" (22.0 cm x 10.0 cm x 10.7 cm)
WEIGHT:	2.1 lb. (1.7 kg)

9. CROSS SENSITIVITIES FOR 4101-26 HF GAS SENSOR MODULE

Gas	Concentration	Indicator
HF	9 ppm	9 ppm
HCl	3 ppm	6 ppm
H ₂ S	29 ppm	0 ppm
Cl ₂	1 ppm	>9 ppm
NO ₂	3 ppm	5 ppm
NH ₃	57 ppm	0 ppm
SO ₂	5 ppm	>9 ppm
CO	1,000 ppm	0 ppm
H ₂	100%	0

10. 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,

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.

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