

# XChem Electrochemical Sensors





# Important Instructions

Net Safety Monitoring, Inc (Net Safety) designs, manufactures and tests products to function within specific conditions. Because these products are sophisticated technical instruments, it is important that the owner and operation personnel must strictly adhere both to the information printed on the product nameplate and to all instructions provided in this manual prior to installation, operation, and maintenance.

## **WARNING**

Installing, operating or maintaining a Net Safety Product improperly could lead to serious injury or death from explosion or exposure to dangerous substances. Comply with all information on the product, in this manual, and in any local and national codes that apply to the product. Do not allow untrained personnel to work with this product. Use Net Safety parts and work procedures specified in this manual.

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# Section 1: Introduction

## 1.1 Models covered

The Net Safety XChem electrochemical toxic gas sensors are designed specifically for use with the Net Safety Millennium II Transmitter (models M21, M22, or M2B). This sensor is both versatile and reliable for fast, accurate, and continuous monitoring of gases in extreme environments.

The sensor assembly consists of a factory sealed explosion proof enclosure (housing) rated for hazardous locations and a replaceable sensor module. This sensor must only be used with a Net Safety Millennium II series transmitter. If the sensor is connected to any other model of transmitter, it will not function and may result in the sensor or transmitter being damaged.

## 1.2 Service support

Technical support for this product can be provided by contacting your local Emerson Process Management/Net Safety representative or by contacting the Net Safety Technical Support department at +1 866 347 3427 or [safety.csc@emerson.com](mailto:safety.csc@emerson.com).

## 1.3 Return of material

To expedite the repair and return of this product, proper communication between the customer and the factory is important. Before returning a product for repair, call +1866 347 3427 or e-mail [safety.csc@emerson.com](mailto:safety.csc@emerson.com) for a Return Material Authorization (RMA) number.

On the return of the equipment, include the following information:

1. RMA number provided to you by Net Safety
2. Company name and contact information
3. Ship all equipment, prepaid to:

Rosemount  
6021 Innovation Blvd.  
Shakopee, MN 55379

4. Mark all packages with the RMA number and type of return (e.g. return for evaluation).

Pack items to protect them from damage and use anti-static bags or aluminum-backed cardboard as protection from electrostatic damage.

*All equipment must be shipped prepaid. Collect shipments will not be accepted.*

## 1.4 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislations/regulations.

## Section 2: Installation

### 2.1 Unpacking and inspection

Carefully remove all of the components from the packaging and verify them against the enclosed packing list. Inspect all components for any obvious damage such as broken or loose parts. If you find any components missing or damaged, notify your local Net Safety representative or the factory immediately.

Recycling of packaging should be taken into consideration and disposed of in accordance with local and national legislations/regulations.

### 2.2 Locate sensor

Prior to installing the sensor, a plan should be developed for placement of the sensor. Although there are no absolute rules for determining the quantity of detectors or location of a sensor, the following points should be considered when planning the installation.

- Carefully locate the sensor in an area where gases may potentially accumulate, considering that light gases tend to rise and heavy gases tend to fall and accumulate in low areas.
- Use redundant systems to enhance protection and reliability.
- Consider air movement patterns in the facility.
- Consider the construction of the facility such as trenches where heavy gases or peaks where light gases may accumulate.
- Seek advice from experts knowledgeable about the gas to be detected.
- Refer to the regulatory publications that discuss guidelines for your industry.

### 2.3 Sensor direct mount or sensor separation

#### 2.3.1 Sensor direct mount

The sensor can be directly attached to a Net Safety Millennium II transmitter and placed in an appropriate location for detecting the target gas, or the sensor can be separated and remotely mounted away from the Net Safety Millennium II transmitter. The sensor should be accessible for calibration and maintenance purposes. The transmitter should be located where it is accessible and visible.

#### 2.3.2 Sensor separation

If the sensor is to be remotely mounted from the transmitter, the sensor must be connected to a certified junction box. In this case, the transmitter is typically located near eye-level for easy access and the sensor is mounted where the gas is likely to accumulate.

In order to ease the calibration process a calibration cup (CCS-1) can be attached to the bottom of the sensor housing and calibration tubing run from the calibration cup to a convenient place for applying the calibration gas, eliminating the need to access the sensor directly. In this case, to compensate for the effect of distance, consider decreasing the calibration tubing length to some length where the end of the tubing to the gas canister is still accessible or increase the calibration gas flow rate between the



## 2.4 Dimensions

The following tables outline the dimensions of the sensor when connected to either the Net Safety Millennium II Transmitter (Figure 2-2) or the Net Safety Millennium II Basic Transmitter/Junction Box (Figure 2-3). Both the transmitter and sensor enclosures are offered in stainless steel and aluminum.

Figure 2-2 Net Safety Millennium II (M21 or M22) enclosure and sensor dimensions

	A		B		C		D		E		F		G		H	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Stainless Steel	5.9	150	5.1	130	4.6	117	8.9	226	6.0	152	5.8	147	2.6	66	2.9	74
Aluminum	6.3	160	5.6	142	5.4	137	9.7	246	6.0	152	5.7	145	2.6	66	2.9	74

Millennium II Transmitter with sensor

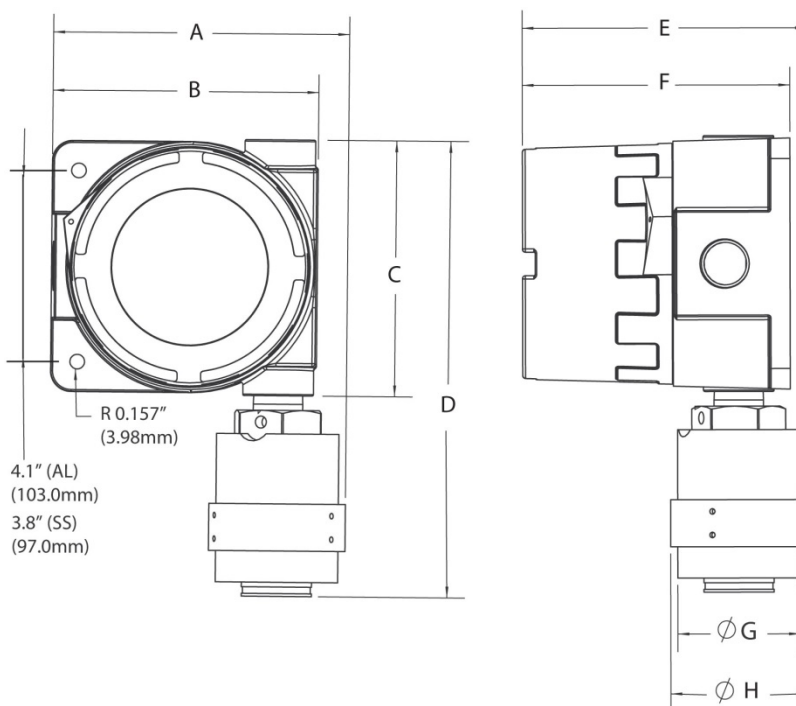
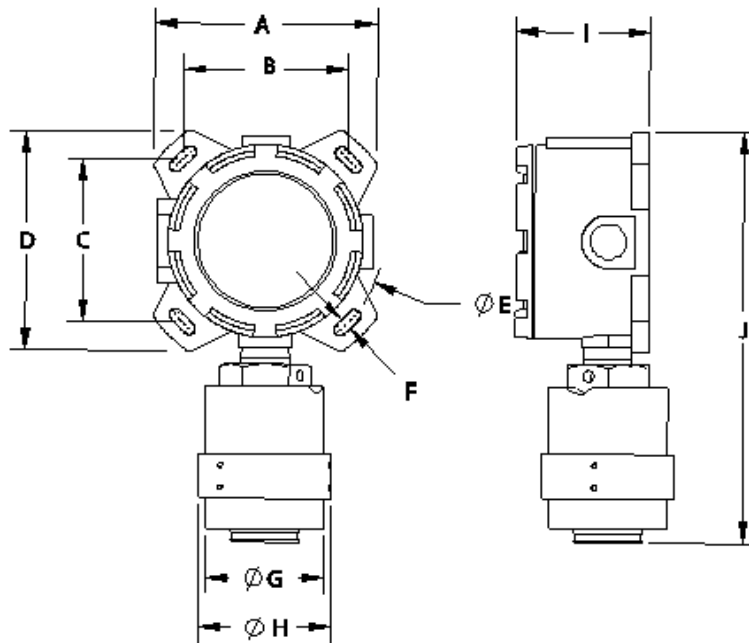


Figure 2-3 Net Safety Millennium II Basic (M2B) or junction box (JB) enclosure and sensor dimensions

	A		B		C		D		E		F		G		H		I		J	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Stainless Steel	4.7	119	3.6	91	3.6	91	4.7	119	5.1	130	0.3	7.6	2.6	66	2.9	74	2.8	71	8.9	226
Aluminum	4.8	122	3.6	91	3.6	91	4.8	122	5.1	130	0.3	7.6	2.6	66	2.9	74	3.0	76	9.0	229

Millennium II Basic Transmitter with sensor



## 2.5 Mounting

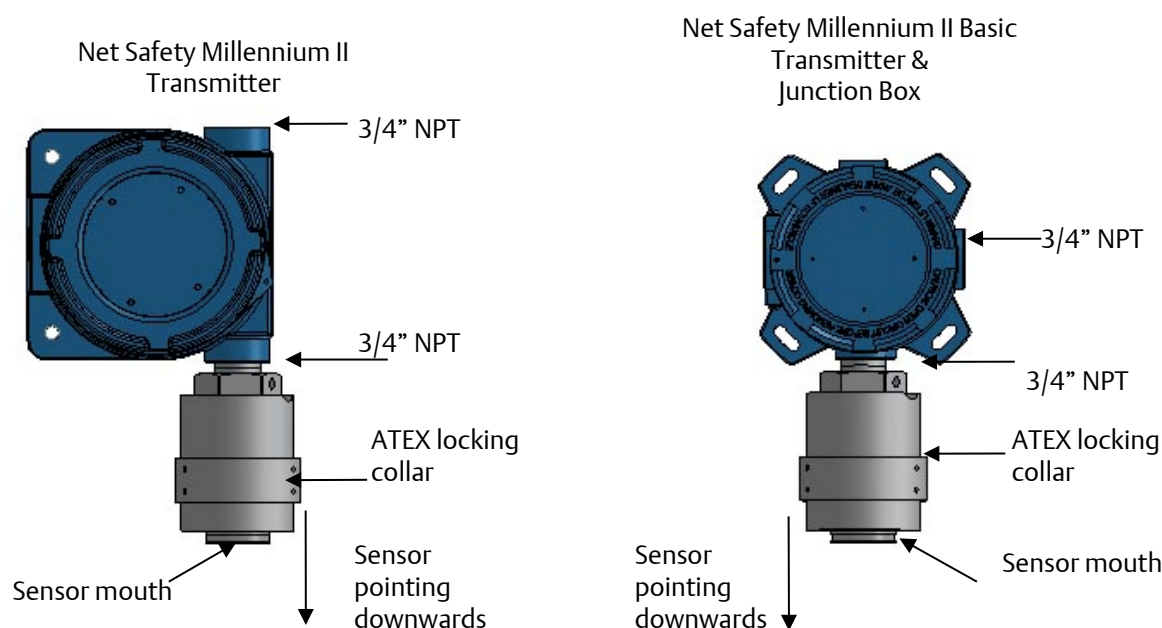
Prior to mounting the sensor to the transmitter or junction box enclosure apply suitable grease (jet lube, etc.) to the threading of the 3/4" FNPT (female NPT) conduit entry of the enclosure as well as the threading on the sensor 3/4" MNPT (male NPT) fitting. This aids in protecting the enclosures from water ingress. After the grease has been applied properly, fit and tighten the sensor to the transmitter or junction box enclosure by using appropriate tools.

The transmitter and junction box have mounting holes to allow mounting to a flat surface or pole as desired. Mounting kit accessories are available to aid in mounting the detector to a flat surface or a pole. Contact your local Net Safety representative for detailed information.

### NOTICE

The sensor must always be mounted vertically such that its mouth is pointed in the downward position as shown in Figure 2-4.

Figure 2-4 Net Safety XChem Sensor mounted to Net Safety Millennium II series transmitters



## 2.6

### Wiring

#### 2.6.1

### Field installation

#### **⚠ WARNING**

Failure to follow these installation guidelines could result in death or serious injury. Ensure that only qualified personnel perform the installation.

Electrical shock could cause death or serious injury. Use extreme caution when making contact with the leads and terminals.

Do not open the transmitter, sensor, or junction box enclosure when in a classified area or when an explosive atmosphere may be present unless the power to the transmitter and sensor has been removed.

#### **NOTICE**

Wiring codes and regulations may vary. Wiring must comply with all applicable regulations relating to the installation of electrical equipment in a hazardous area and is the responsibility of the installer. If in doubt, consult a qualified official before wiring the system.

When separating the sensor from the transmitter, the use of shielded cable is highly recommended to protect against interference caused by extraneous electrical or electromagnetic noise. To meet EN50270:2006 requirements follow the recommendations on cable choice and guidelines as outlined in the Net Safety Millennium II Transmitter manual (MAN-0076) or Net Safety Millennium II Basic transmitter manual (MAN-0082). In applications where the wiring is installed in conduit, the conduit must not be used for wiring to other equipment.

## 2.6.2 Sensor separation distance

The maximum separation distance between the sensor and the transmitter is limited by the resistance of the connecting wiring, which is a function of the gauge of the wire being used. Net Safety recommends that sensor separation must not exceed 2000 feet (610 meters) while using 16AWG (1.31mm<sup>2</sup>) wire. Refer to [Section 6](#) for wire gauges and resistance values.

## 2.6.3 Installation to transmitter or junction box

The Net Safety XChem sensor is supplied with a 3/4" NPT male conduit connection and is intended to be mounted directly to an available 3/4" NPT conduit entry on a Net Safety Millennium II Transmitter or remotely using a certified junction box. Net Safety has an available offering of certified junction boxes designed specifically to work with this sensor. Please contact your local Net Safety representative for further information.

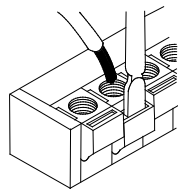
## 2.6.4 Sensor wiring

### **⚠ WARNING**

**Do not open the transmitter, sensor, or junction box enclosure when in a classified area or when an explosive atmosphere may be present unless the power to the sensor has been removed.**

When connecting cable wires, use a small flathead screwdriver to gently press down and hold the spring connector open. Insert the appropriate wire into the open connector hole, releasing the screwdriver to secure the wire. Refer to [Figure 2-5](#) below.

**Figure 2-5 Terminal connection**

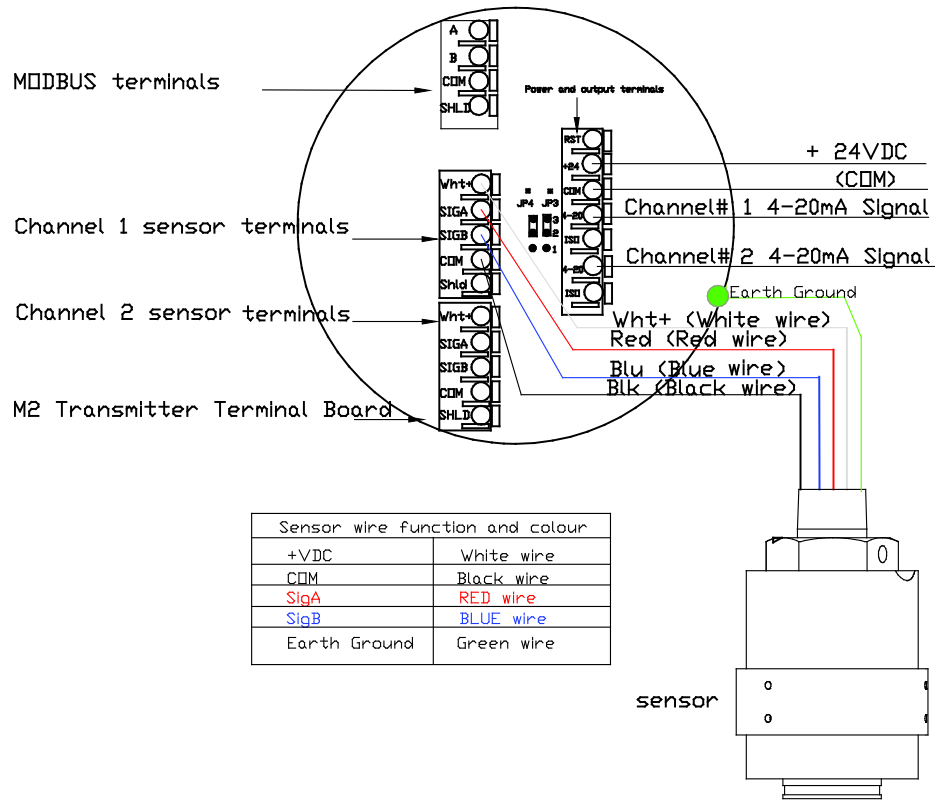


Connect the sensor wires to the Net Safety Millennium II Transmitter or junction box as per the appropriate transmitter or junction box manual. [Figure 2-6](#) outlines the connections to a M21 Net Safety Millennium II transmitter. [Table 2-1](#) outlines the wire colors and their purpose.

**Table 2-1 Sensor wire colors and terminal definition**

Wire color	White	Red	Blue	Black	Green
Marking	+Vdc	Sig A	Sig B	COM	
Function	10.5-32Vdc Connection	Communication signal A	Communication signal B	Common / supply ground	Earth ground

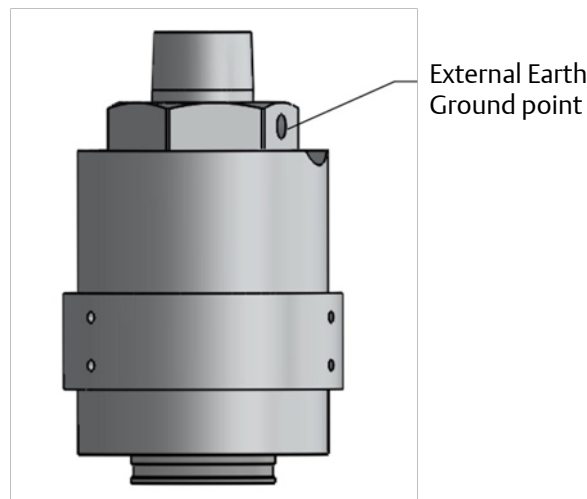
Figure 2-6 Net Safety Millennium II M21 sensor wiring



## 2.6.5 External ground

In order to ensure proper operation of the sensor, an external ground is required. Net Safety recommends that the external ground be connected to the grounding point on the enclosure according to IECEx requirements. Refer to Figure 2-7 for grounding connection location.

Figure 2-7 External grounding point





## 2.7 Calibration

### NOTICE

The Net Safety XChem sensor should be powered up for at least twenty-four (24) hours prior to completing the first calibration.

Although the sensor has been factory calibrated, this calibration may have been disrupted after shipment and calibration after installation is necessary to ensure performance.

Calibration cycles are recommended to be completed every three (3) months to ensure the proper operation of the sensor.

Refer to the respective Net Safety Millennium II transmitter manual (MAN-0076 or MAN-0082) for the calibration procedure.

## 2.8 Installation checklist

Review the following checklist prior to turning the power on to the sensor after installation has been completed:

- Ensure that the transmitter and sensor are properly and firmly mounted
- Ensure that stopping plugs are securely tightened on any unused conduit entries
- Ensure that the transmitter and sensor are not obstructed such that they are accessible and the target gas is not inhibited from reaching the sensor
- Remove the red protective plastic cap/cover from the sensor mouth
- If IP filters are fitted to the sensor, check for any damage or debris
- If calibration cups or splash guards are fitted to the sensor, ensure that they are properly fitted
- Ensure adherence to applicable local guidelines and requirements on wiring and sealing of equipment in hazardous and non-hazardous areas
- Ensure that proper shielding and grounding practices are adhered to and local codes are being followed
- Check system operational voltage and conditions and ensure that they are within the applicable specifications of the sensor
- Verify wiring at all termination and junction points (transmitter, junction box, and power supply)
- If the sensor housing has been opened, ensure that the sensor module is properly seated and making a good connection. Refer to [Section 4.3](#) for more details.
- Perform initial calibration as per [Section 2.7](#).

## Section 3: Operation

### 3.1 Sensor configuration settings

All configuration settings for the Net Safety XChem sensor are accessed through the Net Safety Millennium II series of transmitters. When using the Net Safety Millennium II Transmitter, configuration settings are accessed by selecting menu options through the main display.

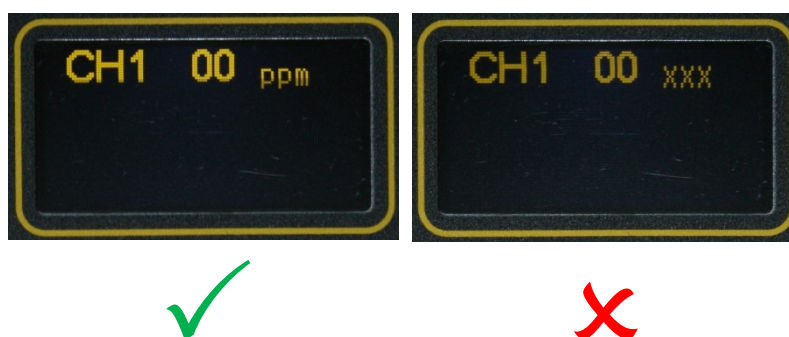
#### Tip

Refer to the relevant transmitter manual prior to attempting a calibration.

### 3.2 Sensor power up

When power is applied to the sensor by the transmitter, a warm-up routine will begin where the sensor will automatically be tested to ensure its proper operation. The warm-up time for the Net Safety XChem sensor is typically between thirty (30) and ninety (90) seconds depending on the sensor type; the ST341 oxygen sensor could take up to an hour to warm-up. During the warm-up period, the Net Safety XChem sensor may not provide accurate results and gas concentration levels may fluctuate during the warm-up period. Refer to the Net Safety Millennium II transmitter manual (MAN-0076) or the Net Safety Millennium II Basic transmitter manual (MAN-0082) for status indicators during this period. Confirm that the Net Safety Millennium II transmitter display properly shows ppm on the display as shown in Figure 3-1. If the display reads xxx, then the sensor cell is not seated properly in the sensor housing. Refer to Section 4.3 for more information.

Figure 3-1 Net Safety Millennium II display examples



### 3.3 Sensor end of life diagnostic

An automatic test of the sensor will be performed daily to ensure the sensor's integrity. This test will be completed one (1) hour after initial power-up and then every twenty four (24) hours following that.

Note that sensor end of life indication is not available on the Oxygen (ST340 or ST341) sensors.

During the test cycle, a period of ten (10) seconds, it is expected that the sensor response time will increase to less than sixty (60) seconds.

If a sensor end of life indication fault is generated, the analog output of the associated transmitter will be 2.5mA (fault condition) for a period of ten (10) seconds. The analog output will then return to its

operational state (4mA with no gas present) for a period of fifty (50) seconds. This cycle will continue until the sensor has been replaced. When using the M21 or M22 transmitter, the display will read "Sensor Reached Life End" on the respective channel and the gas concentration will not be shown.

If used with a Net Safety Millennium II transmitter with relay capabilities, the sensor end of life diagnostic will be indicated through the fault relay. The fault relay will change states (de-energize, indicating a fault condition, upon the detection of the end of life condition. The fault relay will stay de-energized as long as the fault condition is present. When the sensor has detected an end of life condition, the alarm relay will not provide an alarm condition if gas is present, therefore, it is recommended that the sensor be replaced as quickly as possible. For further information on the operation of the relays, please refer to the associated transmitter manual (MAN-0076 or MAN-0082).

## NOTICE

Net Safety Monitoring recommends that if a fire and gas system or other control system is used, that the fault signal (2.5mA) and fault relay (if available) are monitored to indicate sensor faults.

Due to the electrochemical sensor technology used in the Net Safety XChem sensors, the sensor end of life diagnostic may indicate a sensor with decaying response or a non-responding sensor. It is recommended that the sensor be replaced when this fault message is indicated.

Please contact Net Safety Monitoring for replacement sensor modules.

### 3.4 Sensor communication

The Net Safety XChem sensor uses a proprietary protocol to communicate with the Net Safety Millennium II series of transmitters. This sensor should never be connected to any device other than the Net Safety Millennium II series of transmitters. Selected DIP switches and menu options allow communication between the transmitter and sensor. Configuration settings are stored in the memory of the sensor. Incorrect settings will cause the sensor to not communicate properly with the transmitter. If any problems develop, please refer to the troubleshooting section (4.4) of this manual.

### 3.5 Net Safety Millennium II Basic transmitter configuration

When using the Net Safety XChem electrochemical toxic sensor with the Net Safety Millennium II Basic Digital transmitter model (M2B-D), the sensor's range can be changed by accessing a specific Modbus register. The user should write to register 40027 using the preset single register command 0x06. The desired range can then be entered in the register. Refer to 7.1.5 for the available ranges.

When using the Net Safety XChem electrochemical toxic sensor with the Net Safety Millennium II Basic Analog (M2B-A), Analog/HART (M2B-AH), and Relay (M2B-R) transmitter models the sensor's range can be changed to facilitate the need to accurately detect different gas concentrations. This is done by making use of the transmitter's DIP Switch 2 positions as seen in the tables below. Select the transmitter's DIP Switch 2 position that gives the range of gas to be detected.

### 3.5.1 Hydrogen sulfide sensor (ST320)

Table 3-1 Net Safety Millennium II Basic transmitter DIP switch 2 positions for the ST320 sensor

Position 1	Position 2	Position 3	Position 4	Range (Setting)
ON	OFF	OFF	OFF	Range 1 (20ppm)
OFF	ON	OFF	OFF	Range 2 (50ppm)
OFF	OFF	ON	OFF	Range 3 (100ppm)

### 3.5.2 Carbon monoxide sensor (ST360)

Table 3-2 Net Safety Millennium II Basic transmitter DIP switch 2 positions for the ST360 sensor

Position 1	Position 2	Position 3	Position 4	Range (Setting)
ON	OFF	OFF	OFF	Range 1 (500ppm)
OFF	ON	OFF	OFF	Range 2 (1000ppm)

## 3.6 Fault conditions

The Net Safety XChem sensor will provide a number of fault conditions that the Net Safety Millennium II transmitter will translate into an analog or fault relay output. These fault conditions are outlined in the following table.

Fault condition	Analog output	Fault relay output
Sensor zero drift	2.5mA	Fault
Memory fault	2.5mA	Fault
Sensor nearing end of life	Alternating 2.5mA for ten (10) seconds and normal level fifty (50) seconds	Alternating 2.5mA for ten (10) seconds and normal level fifty (50) seconds
Calibrate Sensor	2.5mA	Fault

## Section 4: Maintenance

### 4.1 Cross sensitivities

This relates to the fact that certain compounds and or gases can cause a reaction and hence some effects or response from the sensor. See the tables below for a list of these cross sensitive gases/compounds. For more information, please contact Net Safety.

#### **NOTICE**

The values listed below are typical values and should not be used as a basis for cross calibration. Cross sensitivities may not be linear and should not be scaled either. The data provided is based on gassing for a minimum of five (5) minutes using the gas sensor manufacturers test equipment. It should be noted that some cross interference break through will occur if gas is applied for a longer period of time.

#### 4.1.1 Hydrogen sulfide sensor (ST320)

Table 4-1 List of cross sensitive gases/compounds

Cross sensitive gas	Cross sensitive gas concentration	Reading
Carbon monoxide	300 ppm	<3 ppm
Sulfur dioxide	5 ppm	<1 ppm
Nitrogen dioxide	5 ppm	<± 0.5ppm
Nitric oxide	50 ppm	<1 ppm
Hydrogen	100 ppm	<1 ppm
Chlorine	1 ppm	0 ppm
Ethylene	100 ppm	0 ppm
Carbon dioxide	5000 ppm	0 ppm

## 4.1.2 Carbon monoxide sensor (ST360)

Table 4-2 List of cross sensitive gases/compounds

Cross sensitive gas	Cross sensitive gas concentration	Reading
Hydrogen sulfide	15 ppm	< 0.1 ppm
Sulfur dioxide	5 ppm	0 ppm
Nitrogen dioxide	5 ppm	-0.5ppm
Nitric oxide	35 ppm	<7 ppm
Hydrogen	100 ppm	<60 ppm
Chlorine	1 ppm	0 ppm
Ethylene	100 ppm	<90 ppm

## 4.2 Bump testing

As part of the site preventative maintenance program Net Safety recommends that a bump test of the sensor is completed every three (3) months. Bump testing consists of a visual inspection of the sensor, applying a known gas concentration to the sensor verifying the accuracy of the response to the specifications of the sensor, and alarm system simulation. If the response is outside of the specifications of the sensor a calibration should be completed. Refer to [Section 2.7](#) for more information. After a calibration has been completed, it is recommended that a bump test be completed to verify accuracy and response of the sensor.

## 4.3 Sensor replacement procedure

Sensors are pre-calibrated at the factory; however, field calibration must be performed as a part of commissioning. When the sensor end of life diagnostic is indicating a fault condition, a calibration can no longer be performed, or the sensor is not operating properly, the sensor module may need to be replaced. Refer to steps below for replacing the sensor module.

### **⚠ WARNING**

Do not open the transmitter, sensor, or junction box enclosure when in a classified area or when an explosive atmosphere may be present unless the power to the sensor has been removed.

### **⚠ WARNING**

Avoid touching any electronic components, as they may be susceptible to electrostatic discharge (ESD). Refer to [Section 5](#) for further information and proper handling instructions of electronic components.

1. Remove power from the sensor.
2. Remove the locking ring by loosening the set screws with 1.5 mm Allen Key tool.
3. Remove the bottom part of the sensor enclosure by turning it in a counter clockwise rotation to expose the sensor module.

4. Carefully remove the sensor module from the sensor housing by pulling the module straight out of the housing. NOTE: DO NOT TWIST THE SENSOR MODULE.
5. Properly dispose of the old sensor module as per local guidelines and regulations.
6. Remove the replacement sensor module from its packaging ensuring not to touch any electronic components as this may cause problems due to an unwanted electrostatic discharge (ESD).
7. Rotate replacement sensor module until it aligns with the guide posts. Once aligned, press firmly into place.
8. Install and hand-tighten the bottom part of the sensor enclosure by turning it in a clockwise direction.
9. Install the locking ring by tightening the set screws with 1.5 mm Allen Key tool.
10. Restore power to sensor via the transmitter.
11. Verify that the display shows ppm and not xxx as shown in [Figure 3-1](#). If the display is showing xxx, then the sensor module is not seated properly. In this case, repeat all steps within this procedure.

## 4.4 Troubleshooting

Sensors and transmitters are not designed to be repaired in the field. If problems should develop, first check for faulty wiring, confirm proper voltage to sensor, and attempt a calibration. If problems persist, please contact Net Safety's technical support department first by phone to try and resolve any issues. If issues cannot be resolved, please follow the procedure in [Section 1.3](#) Return of material.

## 4.5 Storage

The sensor and its electronic components/parts should be stored in locations free from dust, liquid spills, contaminants, and moisture. The storage temperature should be well within the limits of the certified temperatures of the equipment. See [Section 7](#) for certified temperatures.

## 4.6 Spare parts and accessories

Description	Part Number
Calibration cup/splash guard	CCS-1
Calibration Kit	CAL-KIT-1
Calibration Gas	CAL-CYL-AIR (103L Air) CAL-CYL-H2S-10 (58L, 10ppm, H <sub>2</sub> S, nitrogen balanced) CAL-CYL-H2S-25 (76L, 25ppm, H <sub>2</sub> S, nitrogen balanced) CAL-CYL-H2S-50 (76L, 50ppm, H <sub>2</sub> S, nitrogen balanced) CAL-CYL-H2S-A-10 (58L, 10ppm, H <sub>2</sub> S, oxygen balanced) CAL-CYL-H2S-A-25 (58L, 25ppm, H <sub>2</sub> S, oxygen balanced) CAL-CYL-H2S-A-50 (58L, 50ppm, H <sub>2</sub> S, oxygen balanced)  CAL-CYL-CO-250 (103L, 250ppm, CO)
Calibration cup	CCS-1
Separation kit	JB-MPD-A - aluminum JB-MPD-S - stainless steel
Replacement sensor module	ST320-100 (H <sub>2</sub> S) ST341-25 (O <sub>2</sub> ) ST360-1000 (CO)
Ingress protection filter	IPF-001
2" Pole mounting kit	UN-MK-32
Duct mounting kit	UDM-001 (1m sampling pipe) UDM-002 (1.5m sampling pipe) UDM-003 (direct mount to duct)



## Section 5: Electrostatic sensitive device

Definition: Electrostatic discharge (ESD) is the transfer, between bodies, of an electrostatic charge caused by direct contact or induced by an electrostatic field.

The most common cause of ESD is physical contact. Touching an object can cause a discharge of electrostatic energy (ESD). If the charge is sufficient and occurs near electronic components, it can damage or destroy those components. In some cases, damage is instantaneous and an immediate malfunction occurs. However, symptoms are not always immediate—performance may be marginal or seemingly normal for an indefinite period of time, followed by a sudden failure.

To eliminate potential ESD damage, review the following guidelines:

- Handle boards by metal shields—taking care not to touch electronic components.
- Wear grounded wrist or foot straps, ESD shoes or heel grounders to dissipate unwanted static energy.
- Prior to handling boards, dispel any charge in your body or equipment.
- Ensure all components are transported and stored in static safe packaging
- When returning boards, carefully package in the original carton and static protective wrapping
- Ensure ALL personnel are educated and trained in ESD Control Procedures

In general, exercise accepted and proven precautions normally observed when handling electrostatic sensitive devices. A warning label is placed on the packaging, identifying product using electrostatic sensitive semiconductor devices.



## Section 6: Wire resistance table

Distance Feet (Meters)	AWG #20 0.5mm <sup>2</sup>	AWG #18 0.8mm <sup>2</sup>	AWG #16 1.0mm <sup>2</sup>	AWG #14 2.0mm <sup>2</sup>
100 (30.5)	1.02	0.64	0.40	0.25
200 (61)	2.03	1.28	0.80	0.51
300 (91.4)	3.05	1.92	1.20	0.76
400 (121.9)	4.06	2.55	1.61	1.01
500 (152.4)	5.08	3.20	2.01	1.26
600 (182.9)	6.09	3.83	2.41	1.52
700 (213.4)	7.11	4.47	2.81	1.77
800 (243.8)	8.12	5.11	3.21	2.02
900 (274.3)	9.14	5.75	3.61	2.27
1000 (304.8)	10.20	6.39	4.02	2.53
1250 (381)	12.70	7.99	5.03	3.16
1500 (457.2)	15.20	9.58	6.02	3.79
1750 (533.4)	17.80	11.20	7.03	4.42
2000 (609.6)	20.30	12.80	8.03	5.05
2250 (685.8)	22.80	14.40	9.03	5.68
2500 (762)	25.40	16.00	10.00	6.31
3000 (914.4)	30.50	19.20	12.00	7.58
3500 (1066.8)	35.50	22.40	14.10	8.84
4000 (1219.2)	40.60	25.50	16.10	10.00
4500 (1371.6)	45.70	28.70	18.10	11.40
5000 (1524)	50.10	32.00	20.10	12.60
5500 (1676.4)	55.80	35.10	22.10	13.91
6000 (1828.8)	61.00	38.30	24.10	15.20
6500 (1981.2)	66.00	41.50	26.10	16.40
7000 (2133.6)	71.10	44.70	28.10	17.70
7500 (2286)	76.10	47.90	30.10	19.00
8000 (2438.4)	81.20	51.10	33.10	20.20
9000 (2743.2)	91.40	57.50	36.10	22.70
10000 (3048)	102.00	63.90	40.20	25.30

Resistance shown is one way. This figure must be doubled when determining closed loop resistance.

## Section 7: Specifications

### 7.1 Performance

#### 7.1.1 Response time

	Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
T20	10 sec	10 sec	7 sec
T50	15 sec	15 sec	10 sec
T90	36 sec	30 sec	20 sec

#### 7.1.2 Accuracy

Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
0°C to +50°C (+32°F to +122°F) ±6 ppm or 17% of reading, whichever is greater	0°C to +50°C (+32°F to +122°F) ±13 ppm or 5% of reading, whichever is greater	0°C to +50°C (+32°F to +122°F) ± 0.5% Vol.
-40°C to 0°C (-40°F to +32°F) ±7 ppm or 27% of reading, whichever is greater	-20°C to 0°C (-4°F to +32°F) ±32 ppm or 17% of reading, whichever is greater	-20°C to 0°C (-4°F to +32°F) ± 1.5% Vol.

#### 7.1.3 Zero Drift

Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
<5% full scale per year	<5% full scale per year	<5% full scale per year

#### 7.1.4 Repeatability

Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
<3% full scale	<3% full scale	<3% full scale

#### 7.1.5 Detection Range

Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
20 ppm 50 ppm 100 ppm	500 ppm 1000 ppm	25% Vol.

## 7.1.6 Calibration Frequency

Three (3) months

## 7.1.7 Unpowered storage time

Six (6) months

## 7.2 Environmental

### 7.2.1 Storage temperature

Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
+3°C to +20°C (+37°F to +68°F)	+3°C to +20°C (+37°F to +68°F)	0°C to +20°C (+32°F to +68°F)

### 7.2.2 Operating temperature

Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
-40°C to +50°C (-40°F to +122°F)	-20°C to +50°C (-4°F to +122°F)	-20°C to +50°C (-4°F to +122°F)

### 7.2.3 Relative humidity

Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
15-90% relative humidity, non-condensing	15-90% relative humidity, non-condensing	15-99% relative humidity, non-condensing

### 7.2.4 Metallurgy (housing)

316 Stainless steel and 6061 anodized aluminum.

### 7.2.5 Ingress protection

IP64

### 7.2.6 Weight

Stainless steel: 3.5 lbs, 1.4 kg  
Aluminum: 1 lb, 0.4 kg

## 7.3 Electrical

### 7.3.1 Voltage

10.5 to 32 Vdc

### 7.3.2 Power Consumption

	Hydrogen Sulfide (ST320)	Carbon Monoxide (ST360)	Oxygen (ST341)
Peak inrush	667 mA (16.0 W) at 24 Vdc	655 mA (15.7 W) at 24 Vdc	685 mA (16.4 W) at 24 Vdc
Operational	13 mA (0.3 W) at 24 Vdc	13 mA (0.3 W) at 24 Vdc	13 mA (0.3 W) at 24 Vdc

## 7.4 Separation

Up to 2000 feet (610 meters) with 16AWG (1.31mm<sup>2</sup>) wire.

## 7.5 Warranty

2 years

## Section 8: Certifications

### 8.1 North America



Class I Division 1 Groups B, C D T5  
Ex d IIB+ H<sub>2</sub> T5  
Class I Zone 1 AEx d IIB +H<sub>2</sub> T5  
-40°C ≤ Ta + 75°C (sensor dependent)  
IP 64

### 8.2 IECEX

II 2G Ex d IIB+H<sub>2</sub> T5 Gb  
-40°C ≤ Ta + 75°C (sensor dependent)  
IP64  
IECEX CSA 11.0006

### 8.3 EMI/EMC

EN 50270:2006

## Section 9: Ordering information

Model	Description	
ST	Electrochemical toxic gas sensor compatible with all Net Safety Millennium II Transmitters	
	Type	Performance
	320	Hydrogen Sulfide (H <sub>2</sub> S), 0-20/50/100ppm, Field Selectable
	341	Oxygen (O <sub>2</sub> ), 0-25%
	360	Carbon Monoxide (CO), 0-500/1000ppm, Field Selectable
	Housing	Enclosure Material
	A	Aluminum
	S	Stainless Steel
	Range	Sensor Range (Type Specific)
	-100-ASSY	ST320 and ST330 Only
	-1000-ASSY	ST360 Only
	-25-ASSY	ST341 Only

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