Foxcroft Equipment & Service, Co. Inc.

The Calibration Book

For detector models: FX-1, FX-1500, FX-1502, FX-1504 and FX-2

Warning!
Please Read Carefully and Save.

Table of Contents

Important Safety Information 3

Introduction 4

1 CALIBRATION 5

2 SHORT GAS LEAK TEST 9

3 FULL SENSOR CALIBRATION 10

4 FX EASY CALIBRATION 13

5 GAS SENSOR REPLACEMENT 17

6. PARTS LISTING 19

9 MONTHLY SENSOR TEST LOG 20

10 WEEKLY ELECTRONIC TEST LOG 21

7 SERVICE 23

11 PRODUCT WARRANTY 25

IMPORTANT SAFETY INFORMATION

Please read and observe the following:

All functions of this gas detection system must be verified on a regular basis.

WARNING: Target calibration gas contains toxic gas and should only be used by personnel who are fully trained in gas calibration procedures. All safety procedures and warnings on the gas bottle should be read, understood, and observed.

HELPFUL IDENTIFIERS

In addition to information on installation and operation, this instruction manual may contain WARNINGS pertaining to user safety, CAUTIONS regarding possible instrument malfunction, and NOTES on important, useful operating guidelines.

WARNING: A warning looks like this. It warns you of the potential for personal injury

CAUTION: A caution looks like this. It alerts you to the possibility of instrument malfunction or damage.

NOTE: *A note looks like this. It alerts you to important operating information.*

Introduction

All functions of gas detection systems must be checked and verified on a regular basis.

Important: *All trimmers required in the calibration procedures are in the Gas Sensor Enclosure. Please take a few minutes to review the logistics of trimmers.*

WARNING: Do not attempt to calibrate any trimmers in the Remote Alarm Unit. These trimmers are factory set.

Calibration

Figure 1

Important: *To calibrate the gas sensor a certified target calibration kit is required. The Calibration Gas Kit includes one target gas cylinder, regulator, tubing and certification sheet. A separate calibration kit is required for each type of gas you monitor.*

Tools required:

- Jeweler's Screwdrivers (full calibration only)
- Calibration nose with O-Ring and caps (Provided with all gas sensors)
- Calibration Gas Kit (pictured below)
- Digital Voltmeter (full calibration only, optional)

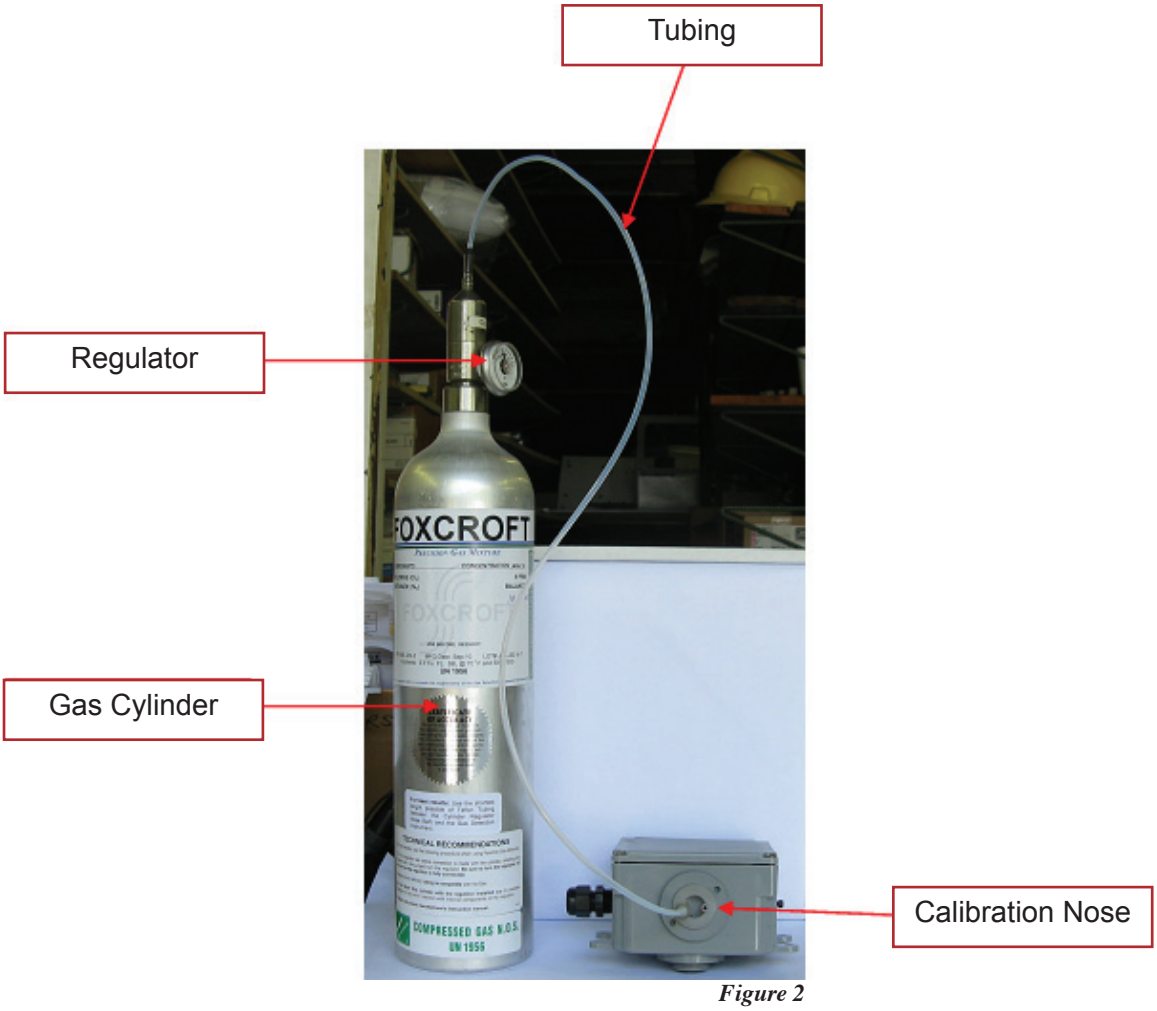

Figure 2

WARNING: Toxic gas sensors are supplied precalibrated, and the sensitivity of the sensor should not drift by more than 2% of full signal per month.

The full calibration procedure is not a requirement for normal operation of the Foxcroft Gas Detectors. Full calibration is only necessary when it has been determined that there is a problem with the sensor, and only after the problem has been repaired, or the sensor has been replaced. However, full gas calibration is a good safety procedure, and is recommended as such, in this instruction manual, for the gas detector. If your on-site safety procedures require a gas detector test (which they should), we recommend a short gas leak test rather than a full calibration. There are two reasons for this:

1. The gas sensor is designed for ambient air conditions, and can eventually be “poisoned” by repeated overexposure to the test and target gases. This is usually noted as a gradual elevation in the zero reading over time and exposure to the test and target gases.

2. If the calibration is done improperly, or with old test gas (it has a shelf life listed on the cylinder), it could seriously impair the sensitivity and function of the gas detector.

WARNING: Target calibration gas contains toxic gas and should only be used by personnel who are fully trained in gas calibration procedures. All safety procedures and warnings on the gas cylinder should be read, understood, and observed.

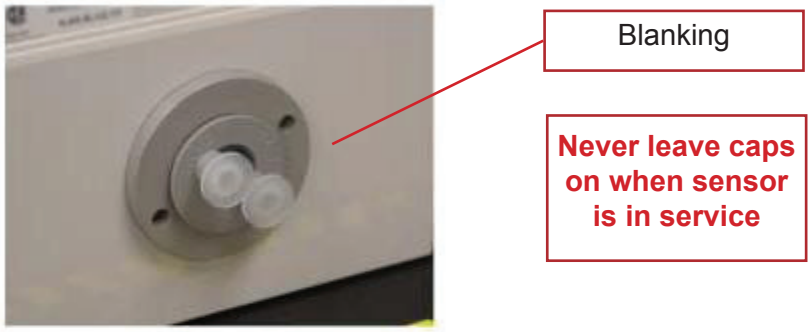

Figure 3

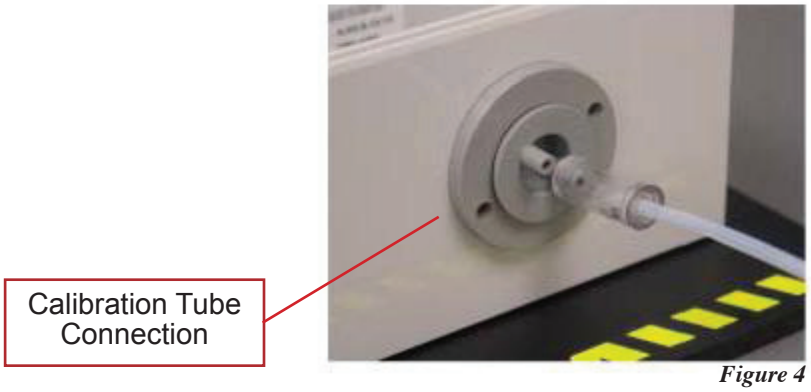

Figure 4

E-Z Cal Sensor Controls

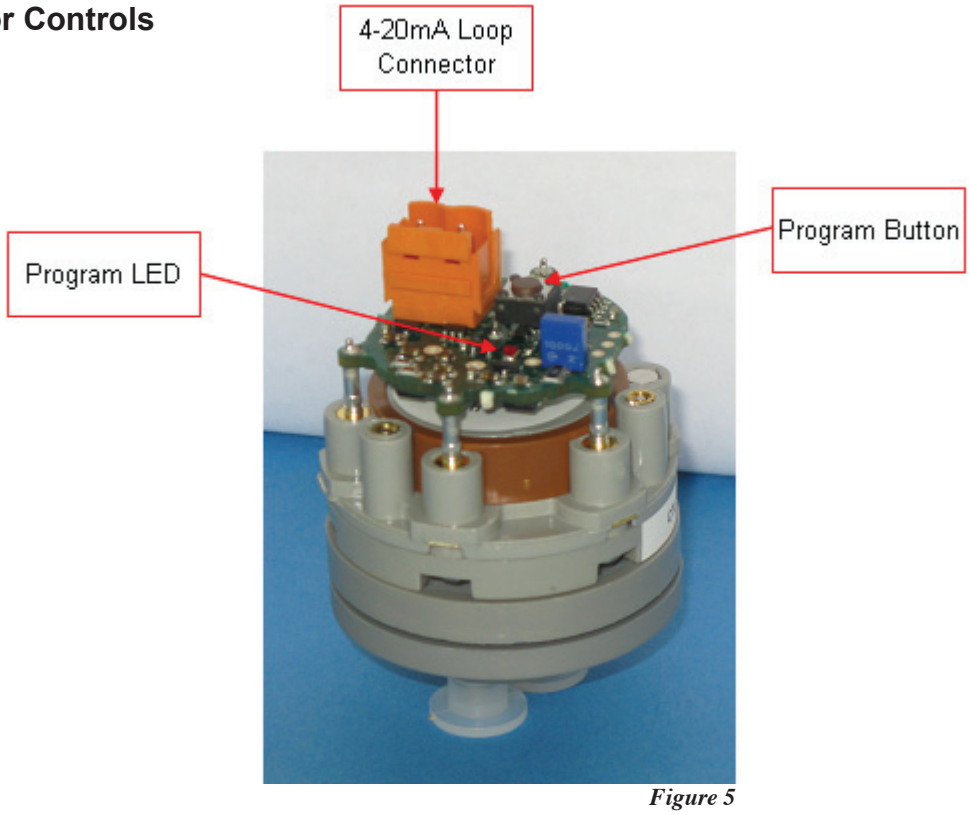

Figure 5

Short Gas Leak Test

Short Gas Leak Test

Important: *This test is not a calibration; it is only to test the gas sensor response to a gas leak. Short gas leak tests can only be done with a known target concentration gas.*

It is **very important** *that this test sets off all the alarms and the target concentration gas level is displayed on the LED display.*

Full calibration is required if the test fails to set off alarms and the target concentration gas level is not displayed on the LED display.

1. The Remote alarm unit must be at zero on the LED display.

2. Install the calibration nose in the collar plug; be sure the nose is sealed properly and is isolated from the atmosphere.

3. Connect the target calibration gas sample tubing to the nose.

4. Apply target calibration gas with a known concentration.

5. Wait for a stable reading to be obtained (five minutes is a suitable period).

6. The known target gas concentration level should be indicated on the LED display and all the alarms should be set off including the buzzer.

7. If the target calibration gas level is indicated on the LED display and the alarms are set off including the buzzer, test is complete. Remove calibration nose, LED display should zero in a few minutes. Reset danger alarm.

8. If the target calibration gas level is not indicated on the LED display and or fails to set off all alarms a full calibration is required.

Full Sensor Calibration

Full Sensor Calibration

Each sensor is supplied precalibrated, and the sensitivity of the sensor should not drift by more then 2% of full signal per month. The oxygen sensor which has a single trimmer for span adjustment (see page 12) and has a separate calibration routine.

Important: *Full sensor calibration is only as accurate as the digital millivolt meter being used (or the Toxic Gas Detector LED display), and the freshness of the target gas being used. So it is important to use an accurate digital meter and a fresh target gas cylinder. The Toxic Gas Detector remote alarm unit already has a factory precalibration and calibration should not be required. If you have reason to believe that the display or alarm level calibration of the Detector remote alarm unit is off, we recommend that you contact Foxcroft to arrange an "RMA", to return the entire unit with the sensor for a complete calibration. Foxcroft maintains a serial numbered calibration database for all of our gas detectors. Foxcroft does not recommend electronic calibration of the remote unit in the field.*

1. The gas sensor enclosure mounting system allows easy zeroing and aspiration using the calibration nose provided. With the plug in place and sealing caps fitted, the sensor is completely isolated from the atmosphere. Removing the cap seals allows the calibration target gas to be connected to one of the inlets and exhausted through the other. A flow of 500 milliliter/ minute is recommended.

2. Ensure the sensor is free from the target gas being measured either by purging the sensor with an inert gas, or blanking the sensor from the atmosphere with the calibration nose supplied.

3. Apply a target calibration gas of a known concentration to the sensor.

4. Wait for a stable reading to be obtained (five minutes is a suitable period of time).

Important: *It is very important to maintain weekly and monthly test logs (see pages 20-22). Regular testing ensures the proper operation and life of the detector.*

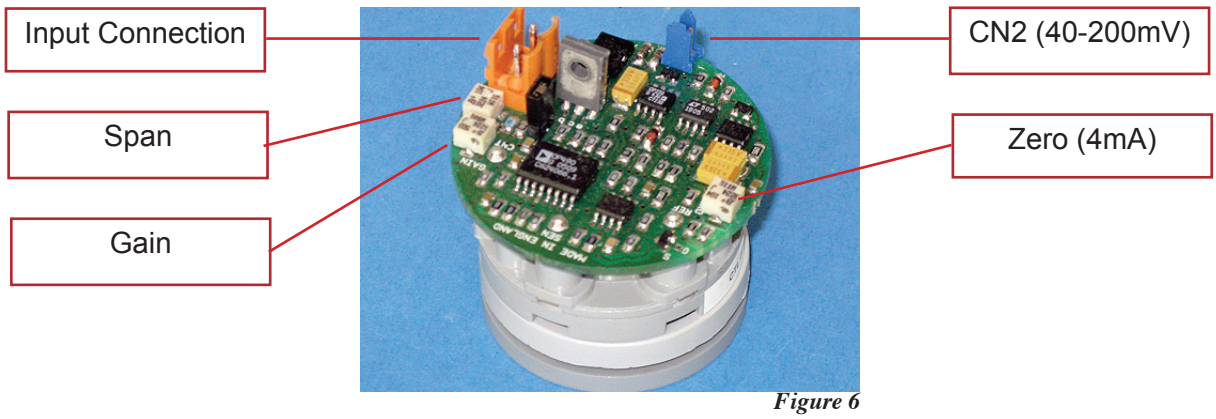

Figure 6

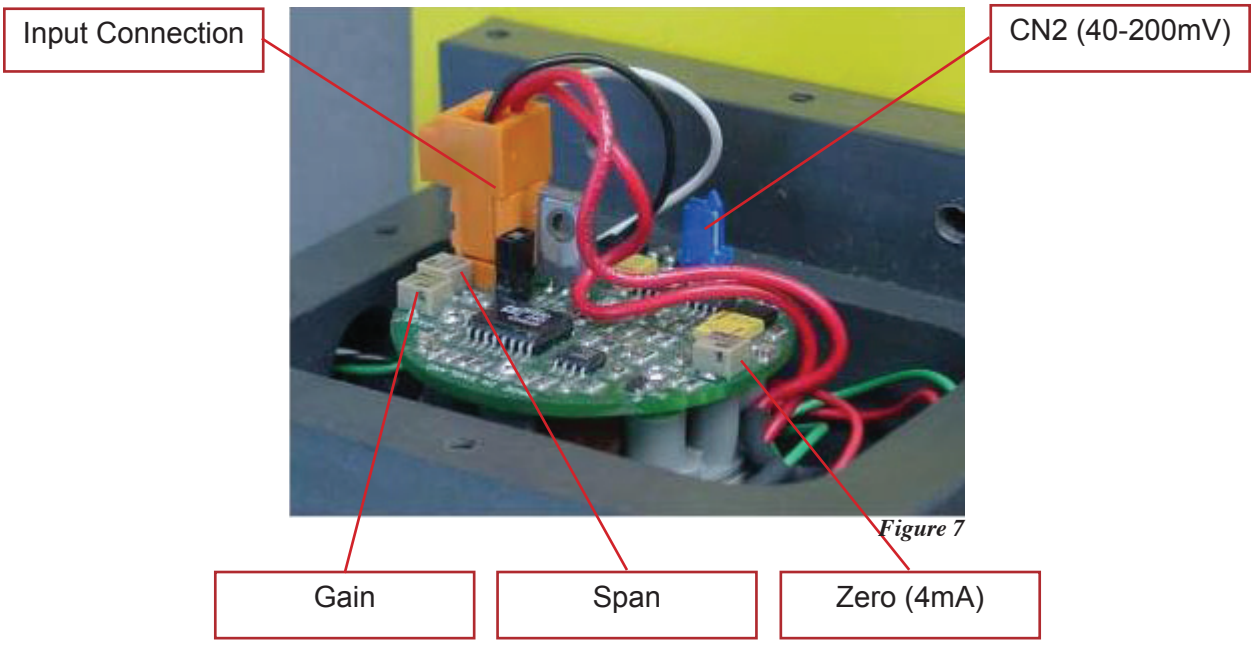

Figure 7

Full Sensor Calibration Procedure

1. Locate the calibration zero/span trimmers on the PCB located in the sensor enclosure or inside the FX-1 enclosure.
2. The circuit board has an additional coarse gain trimmer, which may also be used to calibrate the sensor. However this should not be necessary for routine recalibration, and so should be avoided.
3. For calibration purposes, the signal may be monitored using either a digital multimeter inserted in CN2 (across a 10 ohm precision resistance on the circuit board) 40-200mV or by the remote alarm unit LED display.
4. The gas sensor enclosure mounting system allows easy zeroing and aspiration using the calibration nose provided. With the plug in place and sealing caps fitted, the sensor is completely isolated from the atmosphere. Removing the sealing caps allows the calibtration target gas to be connected to one of the inlets and exhausted through the other. A flow of 500 mls/min is recommended.
5. Ensure the sensor is free from the target gas being measured either by purging the sensor with an inert gas, or blanking the sensor from the atmosphere with the calibration nose supplied.
6. Adjust the zero trimmer until 0 ppm is shown on the LED display or 40mV.
7. Apply a target calibration gas of a known concentration to the sensor.
8. Wait for a stable reading to be obtained (five minutes is a suitable period of time).

9. Adjust the span trimmer until the correct reading is shown on the LED display.

   Or the voltage across CN2 is: $\frac{16 \times (\text{gas concentration})}{\text{Range of Sensor}} + 4 \times 10\text{mV}$

Example: Calibrating a hydrogen sulfide sensor to a range of 0-50ppm using a calibration gas concentration of 20ppm: $\frac{16 \times (20)}{50} + 4 \times 10\text{mV} = 104\text{mV}$

10. Reassemble, test complete.

Figure 8

Oxygen Sensors

Calibration should be carried out in ambient air, and is done simply by adjusting the span trimmer until a reading of 20.9% on a scale of 0-25% is displayed on the LED display.

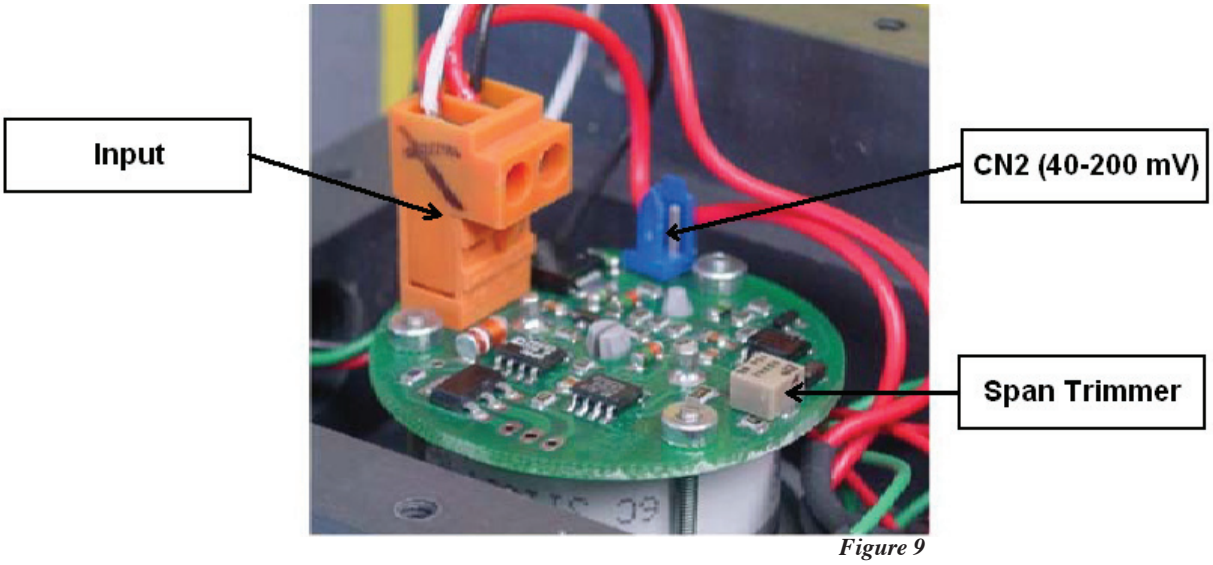

Figure 9

FX Easy Calibration

Performance Characteristics (Chlorine only)

Sensor Type Used	3CLH
Expected Operating Life	Two years in air
Resolution	0.1ppm
Temperature Range	-20°C to +50°C
Pressure Range	Atmospheric +/- 10%
Pressure Coefficient	No data
T_{90} Response Time	≤ 60 seconds
Relative Humidity Range	15-90% non-condensing
Maximum Zero Shift (20°C - 40°C)	-0.2ppm equivalent
Long Term Output Drift	< 2% signal loss/year
Repeatability	2% of signal
Output Linearity	Linear

N.B. All performance data is based on conditions at 20C, 50%RH and 1013mBAr.

Electrical Properties (Chlorine only)

Minimum Input Span	5uA
Maximum Input Span	+/-100uA
Linearity @ 25°C	0.01% Full Scale
Thermal Drift (Input)	0.02% per °C
Linearisation	Linear Response
Output	4-20mA, 2 wire loop powered
Maximum Output Range	3.8 to 21mA
Operating Voltage	10 to 30VDC
Thermal Drift (Output)	2uA per °C
Output Accuracy	+/- 5uA
Protection	Reverse Polarity Protected
Maximum Loop Load	$R_{LOAD} = (V_{supply}-10)*50$ e.g. 700Ω at 24V

Physical Characteristics (Chlorine only)

Weight	58g (including mounting accessory)
Position Sensitivity	None
Storage Life	Six months in CTL Container
Recommended Storage Temperature	0-20°C
Linearisation	Linear Response
Warranty Period	12 months from date of despatch

Calibration Notes

Recalibration is only possible if the output of the sensor at full scale is greater than 50% of the original factory calibration. Failure can occur if:

1. Attempts to recalibrate to a range less than 50% of the original factory calibrated range
2. The output of the sensor has fallen by more than 50% (replace sensor)
3. Incorrect span gas used (use correct span gas)
4. Insufficient time for output to settle after exposing sensor to span gas (apply span gas for 2-5 mins before setting 20mA level)

Transmitter Error Condition

Any time the error condition is set the output will be forced to 21mA and the LED will be held on. Carry out the Reset function to reset the error.

Reset to Factory Calibration

1. Remove loop power from transmitter.
2. Hold down push button and connect loop power to transmitter.
3. LED will blink as soon as power is applied (approx. 2Hz).
4. Transmitter output set to 21mA.
5. Releasing button will start an 8 second timout period.
6. After 8 seconds the factory calibration will overwrite user calibration.
7. LED cleares and transmitter goes back into normal mode.

User Calibration Method

(Span gas = 20mA signal)

1. Connect loop power to the transmitter.
2. Apply required zero gas/air to transmitter for 2 minutes.
3. Hold down button until LED flashes at approx. 1Hz. (4mA level now set)
4. Apply required span gas to transmitter for 2 to 5 minutes.
5. Press and release button (20mA level now set)
6. There will be an 8-second timeout period and flashing LED approx. 8Hz.
7. Calibration is complete, LED clears and returns to normal mode.

Non Standard Span Gas Calibration (Span gas ±5% full range)

1. Calculate the mA signal expected for span gas.

Example:

1. Required 4-20mA range is 0-500ppm	5. Expected signal at 480ppm = (15.36mA + 4mA) = 19.36mA
2. Available span gas is 480ppm	6. Each time button is pressed signal increases by 40uA. When the output reaches 20.8mA the next button press will take the output to 19.2mA. Further button presses will again increase the output by 40uA.
3. Dynamic range is 16mA	
4. Therefore 1mA = 31.25ppm	7. The output range available is 19.2mA to 20.8mA.

2. Carry out steps 1-4 of User Calibration Method
3. Press and release button to set 20mA level.
4. Continued momentary pressing of the button within an eight second period will trim the output by 40uA. When the required output is reached, allow the transmitter to timeout.
5. Calibration is complete, LED clears and returns to normal mode.

Non Standard Span Gas Calibration (Span gas not within ±5% of full range; current source required)

1. Measure the current of the sensor with a known gas concentration. This can then be used to calculate the µA/ppm for the specific sensor.
2. Now calculate the expected current when the sensor is exposed to the full scale of target gas.

Example:

1. Required 4-20mA range is 0-500ppm	4. Therefore sensitivity = 0.11 uA/ppm
2. Available span gas is 300ppm	5. Expected sensor output at 500ppm = 55uA
3. Current from sensor when exposed to span gas = 33uA	

3. Connect current loop power to the transmitter.
4. Connect a current source to the transmitter. For oxidizing sensors (CO, H_2S, SO_2, NO, ...) connect the negative to ‘SEN’ and positive to ‘CNT’. For reducing sensors (Cl_2 or NO_2) connect the positive to ‘SEN’ and negative to ‘CNT’. ‘CNT’ and ‘REF’ terminals on the transmitter board should be connected.
5. Set the current source to zero.
6. Hold down button until LED flashes at approx. 1Hz.

   (4mA level now set in RAM)
7. Set the current source to the value calculated for the full scale of target gas.
8. Press and release button

   (20mA level now set into RAM)
9. There will be an 8-second timeout period and flashing LED approx. 8Hz.
10. Calibration is complete, LED clears and returns to normal mode.

Chlorine - Output vs Temperature

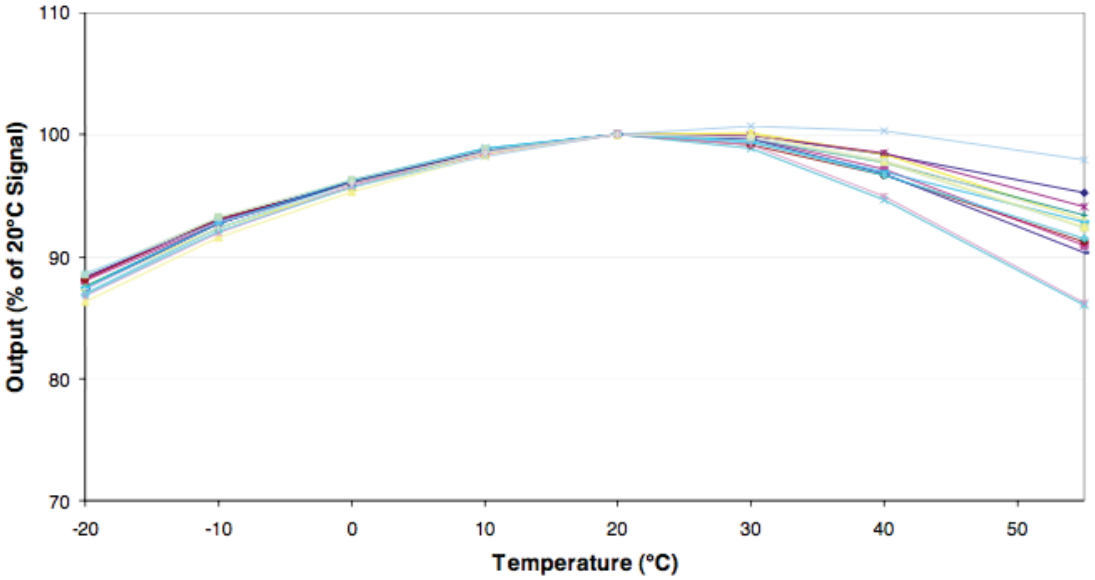

Figure 10

Gas Sensor Replacement

Gas sensor replacement in the Toxic Gas Detectors is easily done with minimal tools.

Tools required:
- Small Jeweler's Screwdriver
- General Small Screwdriver
- Needlenose Pliers

1. Disconnect the AC power from the detector.
2. Remove the sensor enclosure cover by removing (4) screws.
3. Remove the front cover of the sensor enclosure.
4. Carefully pull off the orange wire connector.
5. Unscrew the bulk head nut (see page 18 for diagram). Place the tips of a pair of needlenose pliers in the two holes of the sensor bulk head nut. Turn the ring counterclockwise to loosen the ring, and remove the entire sensor from the enclosure.
6. The transmitter PC board is mounted to the sensor with disconnect pins. Hold the PC board by the edges and carefully pull the board off of the sensor. Some very early sensors, pre- "1994," had the PC board soldered directly to the sensor. This type is not removable. If you have this type, stop here. Do not attempt to solder the new sensor to the transmitter board. The heat from the soldering process will damage the new sensor. You will need to replace the entire sensor/transmitter assembly. All new sensors have removable boards, so future sensor replacements will not be hindered by the additional cost of the transmitter board.
9. Remove the shorting wire from the gold pins on the new sensor, and carefully line up the 3 gold pins on the new sensor with the 3 sockets on the bottom of the transmitter board. Press evenly on the board until it fully seats on the gold pins.
10. Installation of the completed sensor/transmitter assembly is the reverse of its removal.
11. After completing the sensor replacement procedure, power-up the gas detector and allow it to stabilize for 20 minutes (some sensor gas types take up to 24 hours to stabilize). The LED display, should show 0.0 ppm +/-0.1 ppm. If the display is off by more than 0.2 ppm, or the cell failure/problem light is blinking, the sensor requires a full sensor calibration.
12. Refer to page 9 and follow the short gas leak test.

WARNING: Even the ability of the gas sensor to sense toxic gas or low oxygen levels must be verified on a regular basis. It is recommended that the gas sensor be tested by means of a certified gas standard at least every six months.

WARNING: All functions of this FX-1500 Gas Detector must be checked and verified on a regular basis.

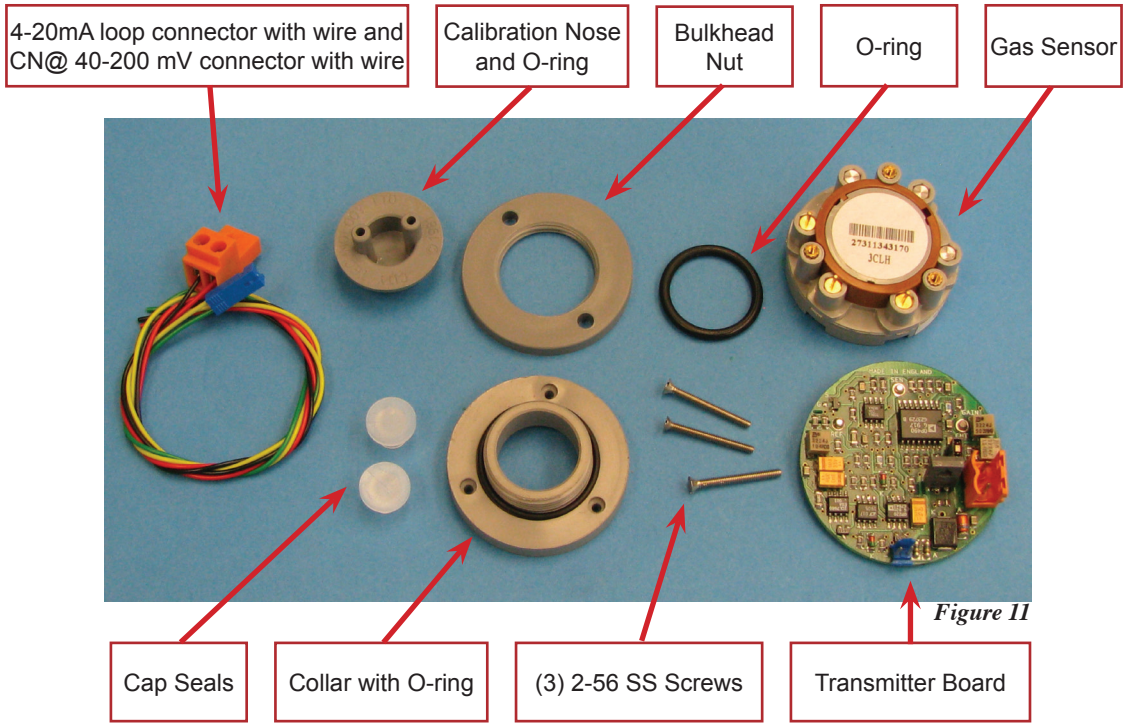

Figure 11

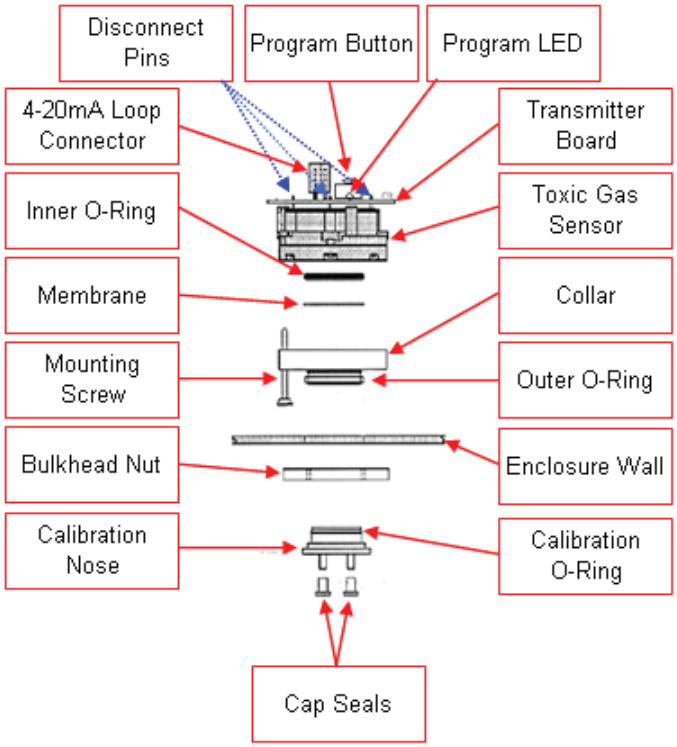

Figure 12

Parts Listing

Electronics

Item Number	Description	Part Number
1	Gas Sensor Only	See specific gas type
2	Gas Sensor Transmittor Only	See specific gas type
3	Gas Sensor with Transmittor	See specific gas type
4	Cap Seals	FX-B017CS (set of 2)
5	Calibration Nose with O-rng	FX-B017
6	Bulkhead Nut	FX-B020 nut
7	Collar with O-ring	FX-B020
8	O-ring	FX-B018
9	(3) 2-56 SS Screws	FX-B25678

Monthly Sensor Test Log

Date	Initials	Date	Initials
Month of		Month of	
Month of		Month of	
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Weekly Electronic Test Log

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Service

System Repair

Customer Service Department

If you need spare parts, assistance in troubleshooting, or repair service, please contact Foxcroft Customer Service at:

Foxcroft Equipment and Service, Co. Inc.
2101 Creek Road, P.O. Box 39
Glenmoore, PA 19343

Tel: **(800) 874-0590**
(610) 942-2888
Fax: **(610) 942-2769**
Email: **service@foxcroft.com**
www.foxcroft.com

Customer Repair / Returns Policy

All systems returned for repair or replacement must be freight prepaid and include the following information:

1. A clearly written description of the malfunction.

2. Name of person to contact and the phone number where they can be reached.

3. Proper return address for shipping system back. Include preferred shipping method.

4. A purchase order if the system is out of warranty to cover costs of repair.

5. A Return Material Authorization Number (RMA) is required before shipping any products for service. Call telephone number above to receive a RMA number.

NOTE: *Returns will only be held at Foxcroft for 90 days. If a decision is not made regarding the repair, the product will be returned.*

Product Warranty

Foxcroft Equipment & Service warrants all products obtained hereunder to be free from defects in material and workmanship for a period of one year from the date of shipment. In the event of a product failure or defect requiring warranty repair, the customer must obtain an RMA number by calling 1-800-874-0590, before returning the product, at the customer's expense to Foxcroft for repair. Warrantor (Foxcroft Equipment and Service) will repair the unit, without charges for parts, labor and return freight.

Foxcroft Equipment & Service is not responsible for damage to its products through improper installation, maintenance, act of God, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or for any unauthorized repair.

Buyer agrees to hold Foxcroft Equipment & Service harmless from all claims for damages arising out of injury or death to any person or damage to any facility, or any other property, or loss of use of any such property, whether such person or property is on or off the installation or activity site for which the equipment or material furnished hereunder is destined and whether such damage, loss destruction or loss of use, injury or death results directly or indirectly from a nuclear incident or for any other cause.

Statements and instructions set forth herein are based upon the best information and practices known to Foxcroft Equipment & Service but it should be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

FOXCROFT

EQUIPMENT & SERVICE COMPANY, INCORPORATED

Serial Number Label of Gas Detector:

Foxcroft Equipment and Service, Co. Inc.
2101 Creek Road, P.O. Box 39
Glenmoore, PA 19343

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(610) 942-2888
Fax: **(610) 942-2769**
Email: **service@foxcroft.com**
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