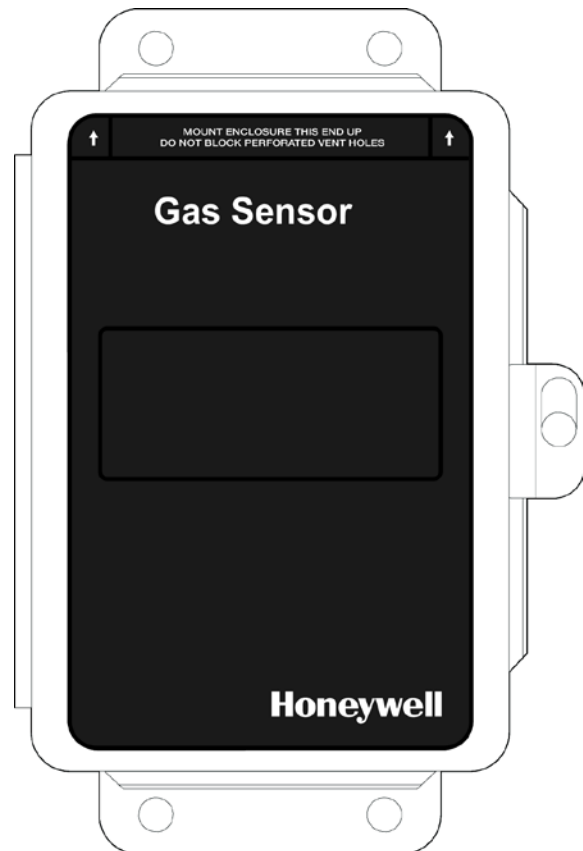


EC-F2 Sensors

for Cl₂, ClO₂, CO, H₂, H₂S, NH₃, and NO₂

Instruction and
Installation Manual



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Introduction

This manual has been prepared to help in the use and installation of the Manning Systems EC-F2 electrochemical sensors for Cl₂ (chlorine), ClO₂ (chlorine dioxide), CO (carbon monoxide), H₂ (hydrogen), H₂S (hydrogen sulfide), NH₃ (ammonia), and NO₂ (nitrogen dioxide). This manual will convey the operating principles of the sensor, ensure proper installation, and demonstrate start-up and routine maintenance procedures for the sensor.

This manual must be carefully followed by all individuals who are responsible for using or servicing the sensor. Warranties made by Manning Systems, Inc. with respect to this equipment will be voided if the equipment is not used and serviced in accordance with the instructions in this manual. If in doubt about a procedure, contact Manning Systems, Inc. before proceeding.

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About This Document

The following Honeywell websites may be of interest to Industry Solution customers.

Honeywell Organization	WWW Address (URL)
Corporate	www.honeywell.com
Life Sciences	www.honeywellanalytics.com
International	www.manningsystems.com

Contact us by telephone at the numbers listed below.

Organization		Phone Number
United States / Canada	Honeywell Analytics Inc. Lincolnshire, Illinois	1-800-444-9935 1-847-955-8200 1-913-712-5580 Fax
Asia Pacific	Honeywell Asia Pacific Inc.	(852) 23 31 9133 Hong Kong
Europe	Honeywell PACE Brussels, Belgium	{32-2} 728-2711
Latin America	Honeywell International Inc. Sunrise, Florida U.S.A.	1-954-845-2600

Contact us at detectgas@honeywell.com

System Description

Manning Systems EC-F2 sensors are three-wire, 4/20 mA sensors for seven gases available in ranges of 0-100 ppm, 0-250 ppm, 0-500 ppm, and 0-1,000 ppm.

The unit exhibits excellent accuracy and precision, with negligible response to common interference gases and dramatic changes in relative humidity. Reliable trip levels as low as 25 ppm can be expected with the 0-100 ppm sensor. The unit exhibits extremely high reliability with no moving parts.

Monitoring equipment must be configured to indicate a fault if the signal is less than 1.5 mA. All signals over 20 mA must be considered a high gas concentration.

System Specifications

Electrical Power: 24 Volts DC regulated, 30 mA. With a heated enclosure, the current draw is 300 mA max.

Output: Linear 4/20 mA output into a load resistor of 250 ohm maximum.

Cable Recommendation: Three-conductor, 18 AWG, stranded, shielded cable with drain wire all enclosed in a vinyl jacket (Belden #8770 or equivalent).

Cable Length to Sensor: 1,500 feet maximum.

Unit Enclosure: NEMA 4, gasketed, steel. Special enclosures available for low temperatures, washdown areas, etc.

Note: The standard EC-F2 is for use in non-classified areas only.

Cl₂ Sensor Specifications

Type: Chlorine-selective electrochemical gas sensor/transmitter Model EC-F2-Cl₂

Method of Detection: Electrochemical

Ranges Available: 0-2 ppm, 0-5 ppm, 0-10 ppm

Accuracy: ±3% of full scale.

Humidity: 5-95% RH (non-condensing). Modifications are necessary for refrigerated areas.

Operating Ambient Temperature Range: -15° F to 120° F. Modifications are available for temperatures below -15° F.

Storage Temperature: -40°F to +70°F. Keep sensor as cool as possible during long-term storage to extend the life of the cell.

Gas Sampling: Diffusion.

Weight: 3 pounds.

Dimensions: 6" high x 4" wide x 3.5' deep.

System Description

CLO₂ Sensor Specifications

Type: Chlorine dioxide-selective electrochemical gas sensor/transmitter Model EC-F2-CLO

Method of Detection: Electrochemical.

Ranges Available: 0-1 ppm, 0-2 ppm

Accuracy: ±3% of full scale.

Humidity: 5-95% RH (non-condensing). Modifications are available for more severe conditions.

Operating Ambient Temperature range: -15°F to 120°F. Modifications are necessary for refrigerated areas.

Storage Temperature: -40°F to +70°F. Keep sensor as cool as possible during long-term storage to extend the life of the cell.

Gas Sampling: Diffusion.

Weight: 3 pounds.

Dimensions: 6" high x 4" wide x 3.5" deep.

CO Sensor Specifications

Type: Carbon monoxide-selective electrochemical gas sensor/transmitter Model EC-F2-CO

Method of Detection: Electrochemical.

Ranges Available: 0-200 ppm, 0-400 ppm

Accuracy: ±3% of full scale.

Humidity: 5-95% RH (non-condensing). Modifications are available for more severe conditions.

Operating Ambient Temperature range: -15°F F to 120°F. Modifications are necessary for refrigerated areas.

Storage Temperature: -40°F to +70°F. Keep sensor as cool as possible during long-term storage to extend the life of the cell.

Gas Sampling: Diffusion.

Weight: 3 pounds.

Dimensions: 6" high x 4" wide x 3.5" deep.

System Description

H₂ Sensor Specifications

Type: Hydrogen-selective electrochemical gas sensor/transmitter Model EC-F2-H

Method of Detection: Electrochemical.

Range Available: 0-2000 ppm

Accuracy: ±3% of full scale.

Humidity: 5-95% RH (non-condensing). Modifications are available for more severe conditions.

Operating Ambient Temperature range: -15°F to 120°F. Modifications are necessary for refrigerated areas.

Storage Temperature: -40°F to +70°F. Keep sensor as cool as possible during long-term storage to extend the life of the cell.

Gas Sampling: Diffusion.

Weight: 3 pounds.

Dimensions: 6" high x 4" wide x 3.5" deep

H₂S Sensor Specifications

Type: Hydrogen Sulfide-selective electrochemical gas sensor/transmitter Model EC-F2-H S.

Method of Detection: Electrochemical.

Ranges Available: 0-50 ppm

Accuracy: ±3% of full scale.

Humidity: 5-95% RH (non-condensing). Modifications are available for more severe conditions.

Operating Ambient Temperature range: -15°F to 120°F. Modifications are necessary for refrigerated areas.

Storage Temperature: -40°F to +70°F. Keep sensor as cool as possible during long-term storage to extend the life of the cell.

Gas Sampling: Diffusion.

Weight: 3 pounds.

Dimensions: 6" high x 4" wide x 3.5" deep.

System Description

NH₃ Sensor Specifications

Method: Electrochemical (diffusion)

Ranges: 0-100 ppm (standard), 0-250 ppm, 0-500 ppm, 0-1,000 ppm

Output: Isolated 4/20 mA, 700 ohms max at 24 VDC

Accuracy: ± 5% generally, but limited by available calibration gas accuracy

Repeatability: ± 2% full scale

Operating Humidity: 5-100% RH (condensing). ATMOS equipped® enviro-adaptive technology option required for condensing conditions or refrigerated areas, and all outdoor applications.

Operating Temperatures: -50°F to +120°F. ATMOS equipped® enviro-adaptive technology option required for refrigerated areas or outdoors.

Sensor Pressure Limits: 0-10 PSIG

Power Source: 24 VDC, 0.5 amp max

Gas Sampling: Diffusion method is standard

Weight: 3 lbs.

Dimensions: 6" high x 4" wide x 3.5" deep

Cable Recommendations: #18/3 shielded cable (Belden #8770 or equal), cable runs <1,500 feet

Enclosure: NEMA 1, gasketed, #16-gauge steel (standard). Stainless steel or explosion-proof designs, including modified enclosures for low temperatures, ventilation ducts, etc., are available (contact Manning Systems).

Note: The standard EC is for use in non-classified areas only.

NO₂ Sensor Specifications

Type: Nitrogen dioxide-selective electrochemical gas sensor/transmitter Model EC-F2-NO.

Method of Detection: Electrochemical.

Ranges Available: 0-20 ppm

Accuracy: ±3% of full scale.

Humidity: 5-95% RH (non-condensing). Modifications are available for more severe conditions.

Operating Ambient Temperature range: -15°F to 120°F. Modifications are necessary for refrigerated areas.

Storage Temperature: -40°F to +70°F. Keep sensor as cool as possible during long-term storage to extend the life of the cell.

Gas Sampling: Diffusion.

Weight: 3 pounds.

Dimensions: 6" high x 4" wide x 3.5" deep.

Installation

Locating the Sensor

Because each sensor is a point measurement, **it is very important that the sensor be located properly.**

One of the most important considerations when installing EC-F2 sensors is that they must be easily accessible for calibration and maintenance. As a general rule, locate sensors no closer than 1 foot from the ceiling.

If the primary application is **personnel protection** (representative concentration reading that an employee would be exposed to), mount the sensor at a height in the breathing zone of the employees. It would typically be about five feet off the ground, which also allows easy access.

If the primary application is the fastest possible leak detection, mount the sensor near the potential leak sources. In the case of ammonia, this is usually near the ceiling as ammonia vapor is lighter than air. In doing this, be aware that the indicated concentration will not be representative of personnel exposure and easy access for the required calibration and maintenance could be compromised.

No matter where the sensor is mounted, it must be easily accessible.

General Mounting Considerations:

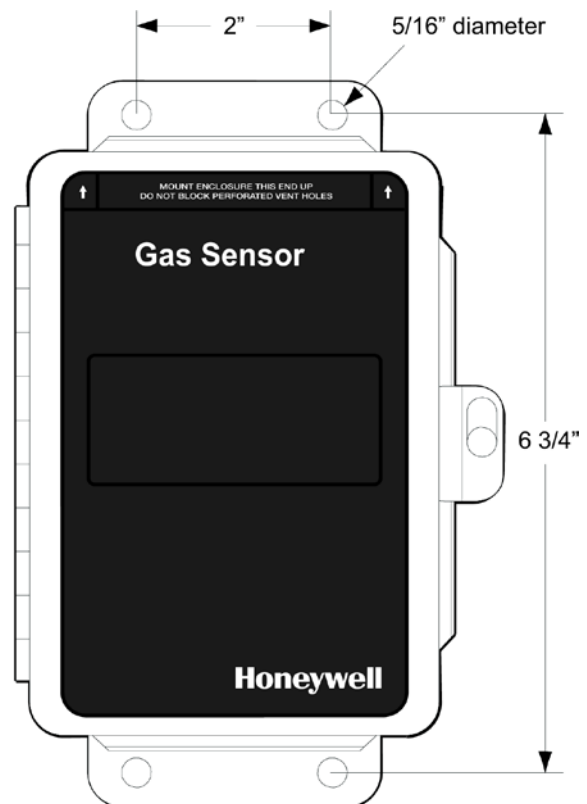
- Must be easily accessible for calibration and maintenance.
- Mount the sensor close to the potential leak source.
- If personnel protection is the primary application, mount in the "breathing zone".
- Protect sensor from water, excessive humidity, and wash-down.
- Take air movement and ventilation patterns into account.
- To prevent electrical interference, keep sensor and wire runs away from mercury vapor lights, variable speed drives, and radio repeaters.
- Protect sensor from physical damage (fork lifts, etc.)
- Do not mount the sensor over a door in a refrigerated area.

- If mounting sensor outdoors, consider prevailing wind direction and proximity to the most likely source of leaks. Protect the sensor from sun and rain as much as possible.
- Never mount the sensor in CA (controlled atmosphere) rooms because normal atmospheric levels of oxygen are required for operation.
- For highly critical locations, more than one sensor should be installed in each room.

Very Important:

- Sensor **must** be mounted vertically.
- **Never** mount flat on a ceiling.
- Enter enclosure **only** through existing hole in bottom.
- **Always** make a drip loop in the conduit..

Figure 1: Mounting Dimensions for the EC-F2 Sensor



Installation

Blast freezers: Never mount sensor above the coil. The ideal location, when possible, is below the bottom of the coil. Try to put in return air and protect the unit from being damaged by product loading and unloading. Keep it away from warm, moist air during defrost. Usually four or five feet off the ground is the best location.

Penthouses:

Multi-Coil (defrost one coil at a time): In this case the best location is usually in the center of the penthouse four or five feet above the grate.

Single Coil (or when all coils defrost at the same time): In this case high moisture conditions can occur and the sensor should be mounted one foot above the grate.

Engine Rooms: The EC-F2 sensor should be mounted in a cool part of the room, if possible. Keep the sensor away from hot air exhausting from electric motors or other machinery. Usually the best location is four or five feet above the floor in a location where the room exhaust fan will move air across the sensor from the potential leak source.

Ceiling Hung Evaporators: When mounting EC-F2 sensors near evaporators, mount the sensor no higher than two feet below the top of the evaporator coil.

DO NOT mount in high air flow (1,200 feet/minute maximum). **NEVER** mount the sensor on evaporators as vibration can damage the sensor.

Other Locations: When mounting EC-F2 sensors in locations such as roof top air units, duct-work, attic spaces, makeup air intakes, etc., contact Manning Systems for application assistance and recommendations.

Installation

Wiring

Figure 2 presents wiring information for the EC-F2 sensor.

Electrical wiring must comply with all applicable codes. Plant equipment that may be involved and operating conditions should be discussed with local operating personnel to determine if any special needs should be taken into account.

Almost all start-up problems are due to improper wiring or monitor configuration. Please follow these guidelines carefully.

Always use three conductor, insulated, stranded, shielded copper cable. Use only three conductor cable, not two cables of two conductor wire.

Do not pull sensor wiring with AC power cables. This will cause electrical interference. Be sure there are no breaks or splices in sensor wiring runs. If cable runs cannot be made without a splice, all connections must be soldered. Soldering should be done using a rosin flux to tie the connecting ends of sensor wires to ensure a positive and long-lasting contact.

Ground the shield at the main control panel. Connect the shield wire in the sensor terminal block labeled **SHLD**.

Tape all exposed shield wire at the sensor to insulate it from the enclosure.

All penetrations into a refrigerated room should be sealed to prevent condensate from forming in the conduit and dripping into the sensor enclosure. Silicone should not be used near the sensor, because silicone can damage the sensor.

Make drip loops for cables going into sensor housings. When heated enclosures are used, follow the special mounting instructions on the enclosure (...*This End Up*).

Mount sensor enclosures through the flange holes as shown in Figure 1, and always mount vertically.

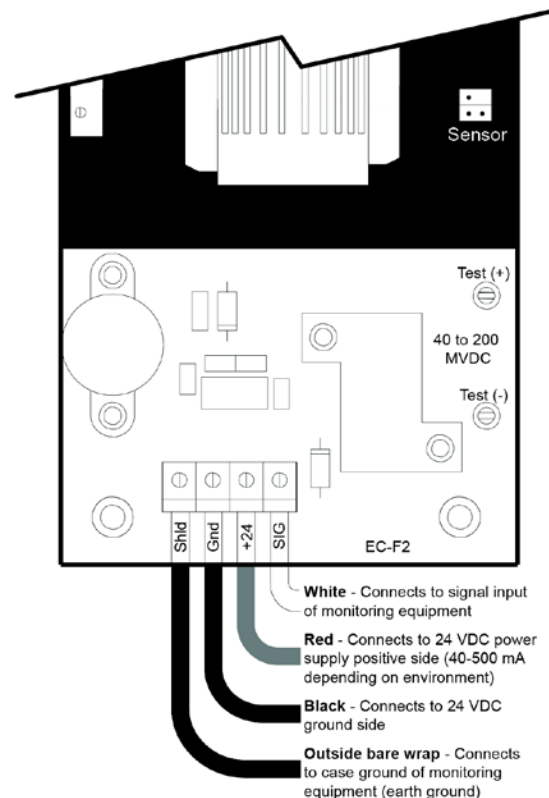
Electrical Power: 24 VDC regulated, 30 mA. With an ATMOS equipped® enclosure the current draw is 500 mA max.

Output: Circuit board mounted sensor provides a linear 4/20 mA output. Monitoring equipment may have a maximum input impedance of 250 ohms.

Cable Recommendation: #18/3 shielded cable (Belden #8770 or equivalent). Length of cable to sensor should be no greater than 1,500 feet. Use only the existing punched holes for connections to the sensor.

Monitoring: The EC-F2-NH₃ Ammonia Sensor may be monitored by the Manning Systems GM-10, GM-4, GM-1, GM-JR or other appropriately configured system. Monitoring equipment must be configured to indicate a fault if the signal is below 1.5 mA. All signals over 20 mA must be considered a high gas concentration.

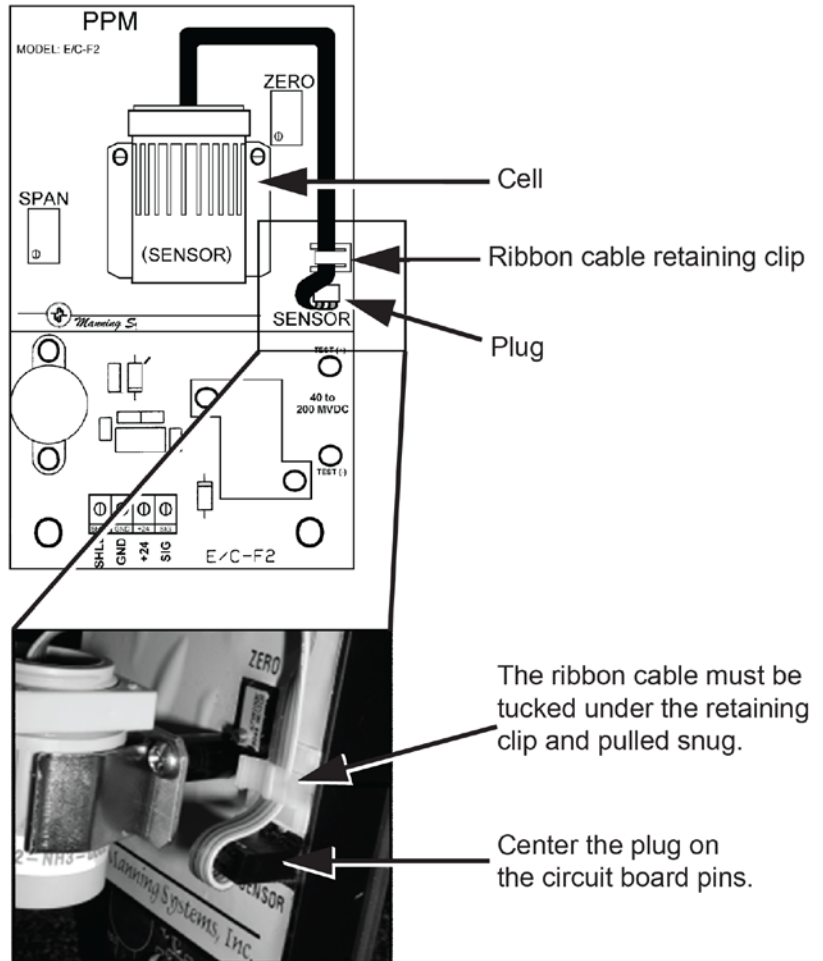
Figure 2: Wiring Diagram for the EC-F2 Sensor



EC-F2 Replacement Cell

Replacement Procedure

1. Slide the ribbon cable out from under the retaining clip.
2. Unplug the ribbon cable and remove the cell from its holder. Discard old cell.
3. Install the new cell, plugging in the ribbon cable. Center the plug properly on the header. Notice that the ribbon cable exits the bottom of the plug and curls back over it.
4. Slide the ribbon cable under the retaining clip and pull it snug so that the plug cannot slide off.
5. Allow the new cell to run for a minimum of one hour then calibrate the sensor with a certified calibration gas.



Operation

Start-Up Procedures

Before applying power, make a final check of all wiring for continuity, shorts, grounds, etc. (see Figure 3, Note 5). It is usually best to disconnect external alarms and other equipment from the sensor until the initial start-up procedures are completed.

After power-up, allow 24 hours for the system to stabilize before testing the sensors. Because sensors are normally located at a distance from the main unit, the test time required and accuracy of the response checks will be improved if two people perform the start-up procedures and use radio contact.

Start-Up Test:

- 1) One person exposes each sensor to a small amount of the gas that is being monitored.
- 2) The second person stays at the control unit to determine that each sensor, when exposed to the gas fumes, is connected to the proper input and responds, causing appropriate alarm functions.

Calibration

The EC-F2 Sensor comes factory calibrated and should require minimal adjustments after installation. There are two pots on the preamp that are used for calibrations.

Calibration kits are available from Manning Systems. Each kit contains certified calibration gas and complete, detailed instructions for calibration of all Manning Systems sensors.

Zero Calibration: After the unit is installed and has been powered up for a minimum of 24 hours, the unit should be zero calibrated by the following:

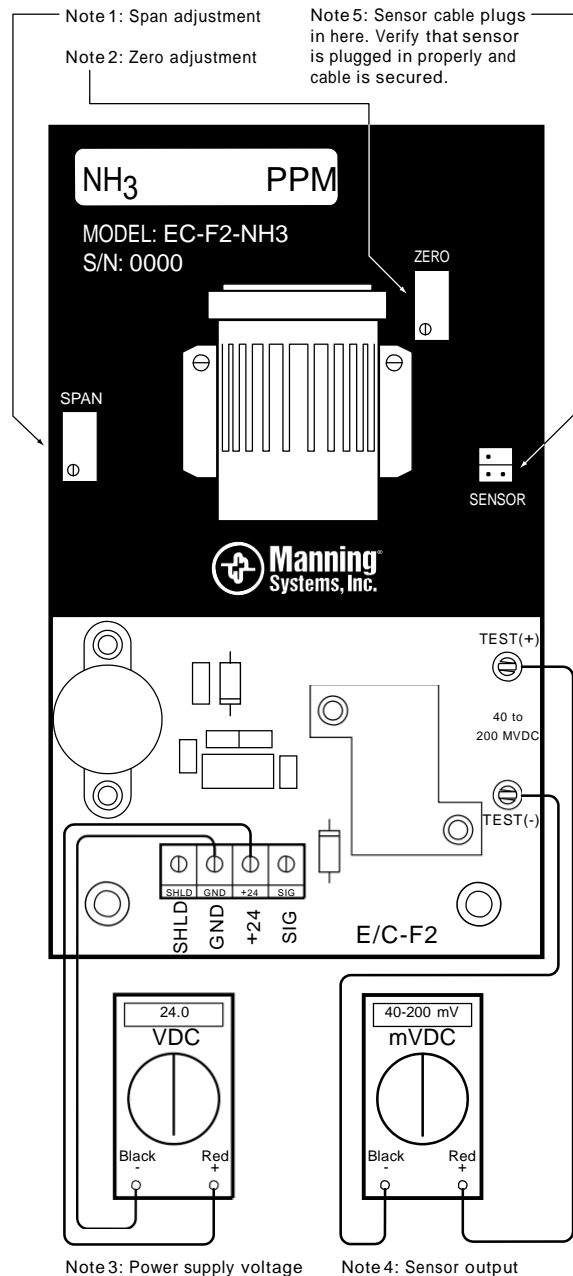
- Be sure the unit is in clean air.
- Adjust the zero pot until the sensor outputs 40 mV from Test (-) to Test (+) (see Figure 3, Notes 2 and 4).

Span Calibration: The unit is factory calibrated and normally does not need to be spanned upon initial installation. **Do not adjust the span pot without certified calibration gas!** If span adjustment is required, the following procedure will span the unit:

- Perform zero adjustment before spanning.

- Apply span gas at 0.8 L/min (span gas must be in air, not nitrogen or other carrier).
- After span gas has been on sensor for two minutes, adjust the span pot until the correct output is achieved (see Figure 3, Note 1).

Figure 4: Checking sensor output, power supply voltage, and zero and span adjustments to the EC-F2 Sensor



Operation

Troubleshooting

If the sensor output is 0 mA: First, verify +24 VDC at the sensor terminal block (see Figure 3, Note 3).

Second, check voltage between Test (-) and Test (+) (see Figure 3, Note 4). Voltage should be in the range of 40 mV to 200 mV corresponding to an actual current flow of 4 mA to 20 mA. If this voltage is 0 mV, the signal has no path to ground. Check monitoring equipment connections and configuration. Input impedance must be 250 ohms or less.

Electrical Interference: This sensor has been designed to be highly resistant to EMI/RFI using multiple stages of filtering and protection. However, in extreme environments, some noise pickup can occur directly through the sensor. Ensure that the bare shield wire of the instrument cable is connected to the terminal block marked *SHLD* at the sensor (not touching the metal enclosure) and properly grounded at the readout unit.

Interference Gases: The EC-F2-NH₃ is designed to be quite specific to ammonia. However, some other gases can affect the reading. Phosphene, methyl mercaptan, and hydrogen can give a slight upscale indication. Bromine, ozone, fluorine, chlorine, and nitrogen dioxide can give a slight down-scale indication. Contact Manning Systems if any of these gases are present in your application.

Maintenance

For proper operation it is essential that the test and calibration schedule be followed. Manning Systems recommends the following maintenance schedule:

- Calibration should be performed with certified calibration gas every six months or after major exposure to a leak. Calibration kits are available from Manning Systems.
- Response test once between calibrations, i.e. at three month intervals. Expose sensor to ammonia/water solution to verify proper sensor

response and alarm functions. Test more frequently in highly critical applications. The response test is not required if multiple electrochemical sensors are installed in the same room.

- All tests and calibrations must be logged.

Sensor Life: These electrochemical cells are extremely reliable, but several things can cause the cell chemicals to become depleted including:

- a period of time,
- exposure to high temperatures,
- exposure to varying concentrations of the target gas,
- exposure to high moisture for extended periods without proper sensor enclosure.

When the cell becomes depleted, the unit will give no indication of failure other than that the sensor will not respond. For this reason it is **absolutely essential that these units be exercised with a gas sample on a regular and timely basis.**

Typical sensor life in a refrigerated area will be three to four years. Typical life in a non-refrigerated area will be one and a half to two years. Exposure to high levels of ammonia will shorten these times. In addition to timely response checks, a preventative maintenance program of periodic cell replacement should be implemented.

When the cell becomes depleted, a replacement cell can be obtained from Manning Systems. Simply unplug the ribbon cable from the pins labeled Sensor, pull the old cell from the spring clip, discard the old cell and replace it with a new one.

The sensor should be calibrated after a 24 hour warm-up period.

Replacement Parts

For replacement parts, contact Manning Systems. Be sure to give serial number of unit and model number.

Limited Warranty

1. Limited Warranty

Manning Systems, Inc. ("Manning") warrants to the original purchaser and/or ultimate customer ("Purchaser") of Manning's Products ("Product") that if any part thereof proves to be defective in material or workmanship within eighteen (18) months of the date of shipment by Manning or twelve (12) months from the date of first use by the purchaser, whichever comes first, such defective part will be repaired or replaced, free of charge, at Manning's discretion if shipped prepaid to Manning at 11511 W. 83rd Terrace, Lenexa, Kansas 66214, in a package equal to or in the original container. The Product will be returned freight prepaid and repaired or replaced if it is determined by Manning that the part failed due to defective materials or workmanship. The repair or replacement of any such defective part shall be Manning's sole and exclusive responsibility and liability under this limited warranty.

2. Exclusions

- A. If gas sensors are part of the Product, the gas sensor is covered by a twelve (12) month limited warranty of the manufacturer.
- B. If gas sensors are covered by this limited warranty, the gas sensor is subject to inspection by Manning for extended exposure to excessive gas concentrations if a claim by the Purchaser is made under this limited warranty. Should such inspection indicate that the gas sensor has been expended rather than failed prematurely, this limited warranty shall not apply to the Product.
- C. This limited warranty does not cover consumable items, such as batteries, or items subject to wear or periodic replacement, including lamps, fuses, valves, vanes, sensor elements, cartridges, or filter elements.

3. Warranty Limitation and Exclusion

Manning will have no further obligation under this limited warranty. All warranty obligations of Manning are extinguishable if the Product has been subject to abuse, misuse, negligence, or accident or if the Purchaser fails to perform any of the duties set forth in this limited warranty or if the Product has not been operated in accordance with instructions, or if the Product serial number has been removed or altered.

4. Disclaimer of Unstated Warranties

THE WARRANTY PRINTED ABOVE IS THE ONLY WARRANTY APPLICABLE TO THIS PURCHASE. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

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