35-3010RK-03
Sample Draw Detector

Part Number: 71-0166RK

Released: 3/12/09

Revision: P1

rkiinstruments.com

Product Warranty

RKI Instruments, Inc., warrants gas alarm equipment sold by us to be free from defects in materials, workmanship, and performance for a period of one year from date of shipment from RKI Instruments, Inc. Any parts found defective within that period will be repaired or replaced, at our option, free of charge. This warranty does not apply to those items which by their nature are subject to deterioration or consumption in normal service, and which must be cleaned, repaired, or replaced on a routine basis. Examples of such items are:

a) Absorbent cartridges

b) Pump diaphragms and valves

c) Fuses

d) Batteries

e) Filter elements

Warranty is voided by abuse including mechanical damage, alteration, rough handling, or repair procedures not in accordance with the operator's manual. This warranty indicates the full extent of our liability, and we are not responsible for removal or replacement costs, local repair costs, transportation costs, or contingent expenses incurred without our prior approval.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESSED OR IMPLIED, AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF RKI INSTRUMENTS, INC., INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL RKI INSTRUMENTS, INC., BE LIABLE FOR INDIRECT, INCIDENTAL, OR CONSEQUENTIAL LOSS OR DAMAGE OF ANY KIND CONNECTED WITH THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY.

This warranty covers instruments and parts sold to users by authorized distributors, dealers, and representatives as appointed by RKI Instruments, Inc.

We do not assume indemnification for any accident or damage caused by the operation of this gas monitor, and our warranty is limited to the replacement of parts or our complete goods.

Specifications

Table 1 lists specifications for the 35-3010RK-03.

Table 1: Specifications

Target Gases & Detection Ranges	Combustible Gas, 0 - 100% LEL Oxygen, 0-25% volume Carbon Monoxide, 0 - 300 ppm
Input Power	24 VDC
Current Draw	200 mA
Construction (housing)	Fiberglass / polyester (NEMA 4X)
Dimensions	15.44 in. H x 12.55 in. W x 8.31 in. D
Weight	14 lbs.
Sampling Method	Sample draw
Sample Flowrate to Sensors	1.2 SCFH (nominal)
Response Time	90% in 30 seconds
Accuracy	±5% of detection range

Description

This section describes the components of the 35-3010RK-03 sample draw detector. The sample draw detector consists of the housing, flow system, and detection system.

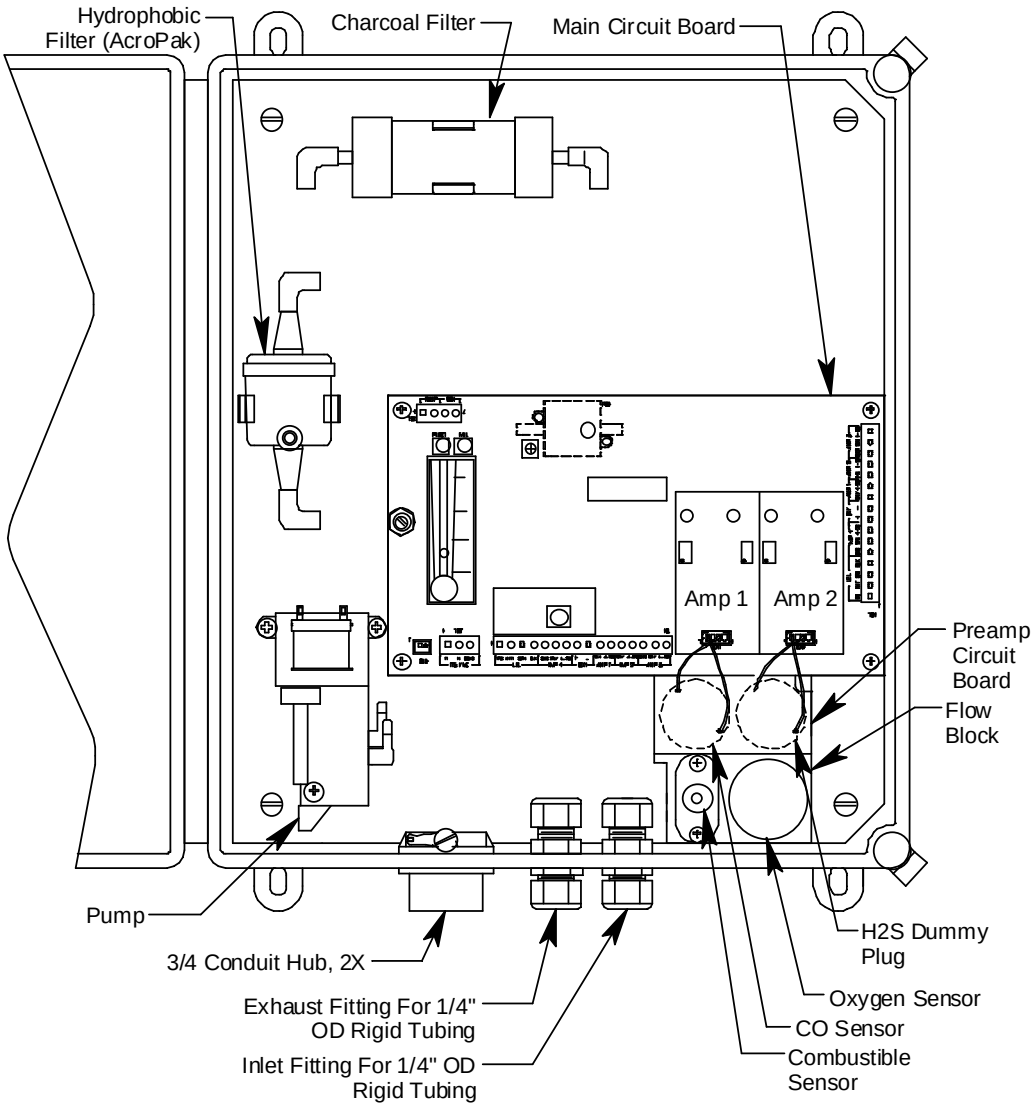

Figure 1: Sample Draw Detector Head Component Location

Housing

The sample draw detector's fiberglass housing is weather- and corrosion-resistant. It is suitable for installation where general purpose equipment is in use. The housing door is hinged on the left side and is secured by two latches on the right side.

Four mounting feet are attached to the back of the housing (one at each corner). Use the mounting feet to install the housing to a vertical surface. Use the two conduit hubs on the bottom of the housing to make wiring connections.

An aluminum subpanel is mounted to the interior of the housing. The sample draw detector's internal components are mounted to the subpanel.

Flow System

The sample draw detector's flow system consists of the INLET fitting, hydrophobic filter, charcoal filter, pump, flowmeter, bypass valve, status lights, pressure switch, flow block, and EXHAUST fitting (see Figure 1). Figure 2 illustrates how the gas sample moves through the flow system. The sample flow to the sensors is controlled by a bypass valve so that the total flow is more than that indicated by the flowmeter. This reduces the time for the sample to reach the sample draw detector from the sampling area.

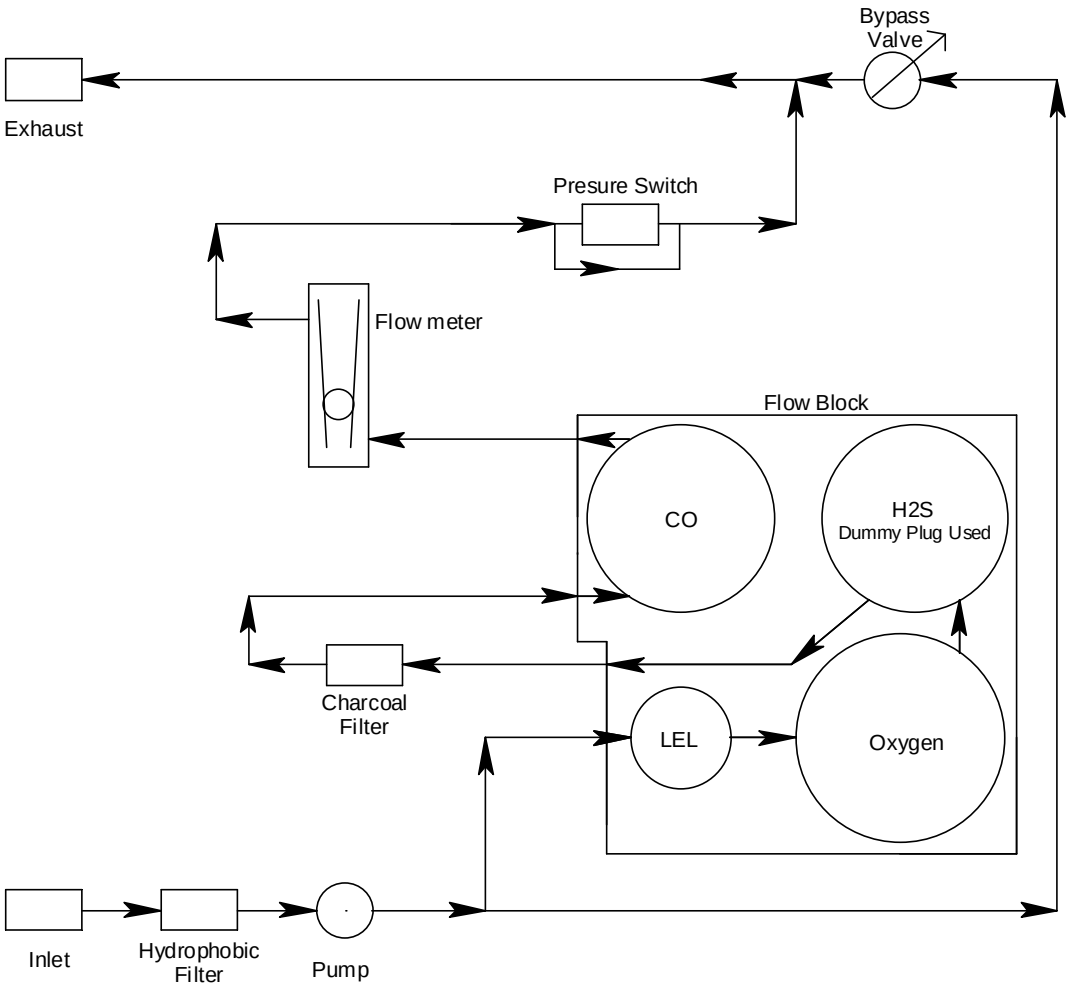

Figure 2: Sample Draw Detector Flow Diagram

INLET fitting

The INLET fitting on the bottom of the housing allows the gas sample to enter the sample draw detector. The INLET fitting accepts 1/4 in. rigid tubing. See the Installation section on page 10 to connect tubing to the INLET fitting.

Hydrophobic Filter

The hydrophobic filter is to the left of the main circuit board. It is held in place by a metal clip. It prevents water and other liquids from contaminating the flow system. Replace the

filter when it appears dirty, discolored, or clogged. If a liquid other than water is drawn into the filter, replace the filter as soon as possible.

Charcoal Filter

The charcoal filter is located above the LEL transmitter. It is held in place by a metal clip. The charcoal filter is placed after the sensor and before the CO sensor in the flow system. It scrubs out interfering gasses which may cause the CO sensor to respond, such as H_2S or certain hydrocarbons. Replace the charcoal filter when false high CO readings are noticed, especially in the presence of H_2S.

Pump

The pump is located to the left of the main circuit board near the bottom left of the sample draw detector. The pump pulls the gas sample into the sample draw detector. The pump operates on 24 VAC, which is generated by the main circuit board from the 24 VDC supplied to the sample draw detector.

Flowmeter

The flowmeter is attached to the main circuit board near the top left corner (see Figure 3.) A ball in the flowmeter column indicates the flow rate to the sensors. The flowmeter measures the flow in the range 0.2 to 2.0 SCFH (Standard Cubic Feet per Hour). Although the sample draw detector will operate down to a flow of 0.6 SCFH, the optimum flow rate is 1.2 SCFH.

Bypass valve

The bypass valve is to the left of the flowmeter. The bypass valve adjusts the flow rate to the sensors. Use a flat-blade screwdriver to adjust the bypass valve.

NOTE: The bypass valve allows fine adjustments of the flow rate. For a wider range of adjustment, use the flow adjust potentiometer (see Figure 3.)

Status lights

Two status lights are above the flowmeter.

Pilot light

The green Pilot light is on when the sample draw detector is receiving power.

Fail light

The red Fail light is on when the sample flow rate is below the low flow level.

NOTE: The factory set low flow level is 0.6 SCFH (±0.2). See “Adjusting the Low Flow Setting” on page 19 to adjust this setting.

Pressure switch

The pressure switch is mounted to the opposite side of the main circuit board. The pressure switch monitors the flow rate to the sensors.

If the flow rate falls below the preset low flow level, the pressure switch causes the fail relay to interrupt the signal in the 4-20 mA line for the CO channel and in the LEL and oxygen sensor signal lines. This causes a downscale reading at the controller on each channel resulting in a fail alarm. The low flow level is factory-set at 0.6 SCFH (±0.2 SCFH).

Flow Block

The flow block is located in the lower right corner of the sample draw detector. All the sensors are installed in the flow block. The flow block routes the sampled air to each sensor.

EXHAUST fitting

The EXHAUST fitting on the bottom of the housing allows the gas sample to exit the sample draw detector. The EXHAUST fitting accepts 1/4 in. rigid tubing. See the Installation section on page 10 to connect tubing to the EXHAUST fitting.

Detection System

The detection system consists of the gas sensors, preamp circuit board, and the main circuit board.

Combustible Gas Sensor

The combustible gas sensor is installed in the lower left of the flow block. The combustible gas sensor includes the sensing elements, flame arrestor, connector, and sensor leads.

Sensing elements

Two sensing elements are protected within the sensor assembly. Through a series of thermal and electronic reactions, these elements produce an output that corresponds to the detection range of the sample draw detector.

The porous flame arrestor allows the gas sample to enter the sensor assembly and contact the sensing element. The flame arrestor also contains sparks within the sensor.

Connector

The top of the sensor includes five pins that plug into the socket connector. This connector allows you to replace the sensor without disconnecting the wiring. The sensor leads are soldered to the connector.

Sensor leads

Four color-coded leads extend from the connector. The leads allow you to connect the combustible gas sensor to the main circuit board.

Oxygen sensor

The oxygen sensor is installed in the lower right of the flow block. The oxygen sensor includes the oxygen cell, connector, and sensor leads.

Oxygen cell

The oxygen cell is protected within the sensor assembly. Through a series of chemical and electronic reactions, the cell produces a millivolt output that corresponds to the detection range of the sample draw detector.

Connector

The cable that extends from the sensor terminates in a socket that mates with a 7-pin male connector. The socket and connector allow you to replace the sensor without disconnecting the wiring. The sensor leads are soldered to the male connector.

Sensor leads

Two color-coded leads extend from the connector. The leads allow you to connect the oxygen sensor to the main circuit board.

Carbon Monoxide Sensor

The carbon monoxide gas sensor is installed in the upper left side of the flow block. It has 4 pins which mate with sockets in the preamp circuit board.

Hydrogen sulfide gas sensor

The hydrogen sulfide gas sensor position is located in the upper right side of the flow block. In the 35-3010RK-03, the hydrogen sulfide gas sensor position in the flow block is occupied by a dummy sensor.

Preamp Circuit Board

The preamp circuit is used to connect the CO sensor to the main circuit board and to secure the sensor in the flow block. Two cables mate to the main circuit board: the one on the left is for the CO sensor signal and the one of the right is for the H_2S sensor signal. Since the H_2S sensor is replaced with a dummy plug in the 35-3010RK-03 the H_2S sensor signal cable carries no signal in this version of the 35-3010RK.

Main Circuit Board

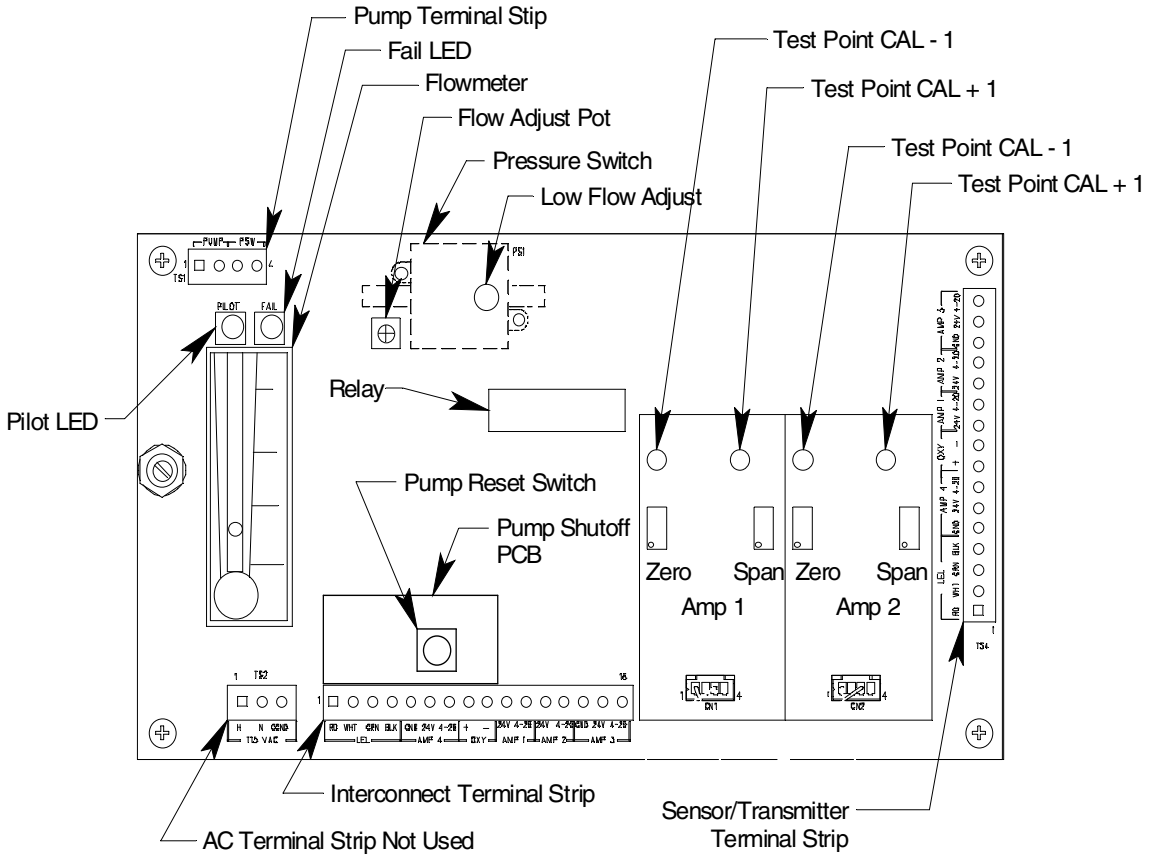

Figure 3: Main Circuit Board

The main circuit board includes the interconnect terminal strip, sensor / transmitter terminal strip, amp 1 circuit, amp 2 circuit, pump shutoff PCB, pump terminal strip, and relay.

NOTE: The flowmeter and status lights are mounted to the main circuit board but are considered part of the flow system.

Interconnect terminal strip

The interconnect terminal strip is the sixteen-point terminal strip near the bottom edge of the main circuit board. Use the interconnect terminal strip to connect the sample draw detector to power and an gas monitoring controller.

Sensor/Transmitter terminal strip

The sensor / transmitter terminal strip is the sixteen-point terminal strip near the right edge of the circuit board. Use the transmitter terminal strip to connect sensors or transmitters to the main circuit board.

NOTE: The sensors and transmitters are factory wired to the sensor / transmitter terminal strip. See the "Installation" on page 10 for all wiring procedures related to the sample draw detector.

Amp 1 and Amp 2 circuits

These circuits are located to the left of the sensor / transmitter terminal strip. They each include test points, a zero pot, and a span pot. Amp 1 is on the left and is for the CO channel. Amp 2 is on the right and is for the H_2S channel.

The zero and span pots are used during calibration. Use the span pot to make adjustments to gas response readings and the zero pot to make adjustments to the zero reading

The test points are labeled CAL-1 and CAL+1 for the CO channel and CAL-2 and CAL+2 for the H_2S channel. A 100 mV - 500 mV output is available at each set of test points for use during calibration.

In this version of the 35-3010RK, the Amp 2 circuit is not used because there is no H_2S sensor installed.

Pump shutoff PCB

The pump shutoff PCB is located to the right of the flowmeter above the interconnect terminal strip. It shuts off the pump during a low flow alarm. The pump reset switch can be used to restart the pump.

Pump terminal strip

The pump terminal strip is the four-point terminal in the top left corner of the circuit board. Use the pump terminal strip to connect the pump and pressure switch to the main circuit board.

NOTE: The pump and pressure switch are factory-wired to the circuit board. See "Wiring the Sample Draw Detector to a Controller" on page 11 for all wiring procedures related to the sample draw detector.

Relay

The relay is approximately in the middle of the circuit board. The relay is a four pole, double-throw (4PDT) relay and is rated for 2 amps at 25 VDC (resistive). If the pressure switch senses a low flow condition, the relay interrupts the 4-20 mA signal from the CO channel and opens one of the lines from each of the LEL and oxygen sensors which will cause a downscale reading at the controller resulting in a fail alarm on these channels.

Installation

This section describes procedures to mount the sample draw gas detector in the monitoring environment and wire the sample draw detector to power and a gas monitoring controller.

Mounting the Sample Draw Combustible Gas Detector

1. Select the mounting site. Consider the following when you select the mounting site.
   - Is there enough room to open the housing door and make wiring connections at the bottom of the housing and tubing connections at the right of the housing?
   - Make sure there is sufficient room to perform start-up, maintenance, and calibration procedures.

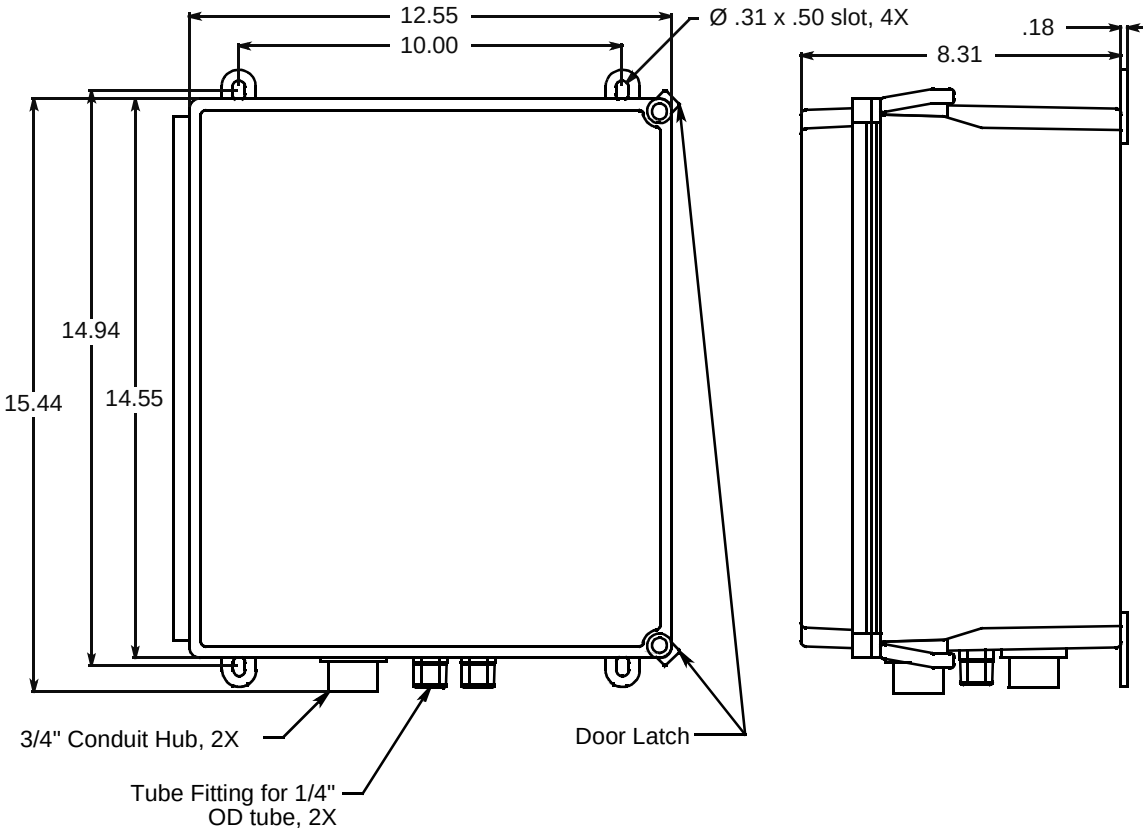

Figure 4: Mounting the Sample Draw Detector

2. Close and latch the housing door.

NOTE: The sample draw detector is shipped with the mounting feet "tucked under" the housing to protect the mounting feet during shipment.

3. Slightly loosen the screw that secures one of the mounting feet to the housing, then rotate the mounting foot 180 degrees.
4. Tighten the screw that secures the mounting foot to the housing.

5. Repeat steps 3 and 4 for the remaining three mounting feet.
6. Position the sample draw housing on a vertical surface at eye level (4 1/2 to 5 feet from the floor).
7. Insert 1/4 in. or 5/16 screws through the slots in the mounting feet to secure the housing to the mounting surface.

Connecting the Sample Lines to the Sample Draw Detector

1. Attach 1/4 in. O.D. rigid polypropylene or rigid Teflon sample tubing to the INLET fitting.

CAUTION: *If you use **flexible** sample tubing (polyurethane is acceptable), use an appropriate insert to seal the connection between the tubing and the INLET fitting.*

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2. Place the opposite end of the tubing at the sampling area.

CAUTION: *Avoid loops or slumps in the incoming sample line. To reduce response time, keep the incoming sample line as short as possible.*

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3. Attach rigid sample tubing to the EXHAUST fitting.
4. Route the opposite end of the tubing to an open area where the sample can safely disperse.

Wiring the Sample Draw Detector to a Controller

WARNING: ***Always verify that the power source is OFF before you make wiring connections.***

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1. Unlatch and open the housing door of the sample draw detector.
2. Guide a nine-conductor 18 gauge, shielded cable or nine 18 gauge wires in conduit through one of the conduit hubs at the bottom of the sample draw housing. If necessary, use both hubs to bring the wires in making sure that all the wires for a particular channel go through the same hub.
3. Connect the cable to the sample draw detector's interconnect terminal strip as shown in Figure 5.
4. Close and latch the housing door of the sample draw detector.

CAUTION: *Leave the cable shield drain wire insulated and disconnected at the sample draw detector. You will connect the opposite end of the drain wire at the controller.*

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5. Route the cable or wires in conduit leading from the sample draw detector to the to the controller.
6. Connect the cable or wires at the controller to the appropriate channels' detector/transmitter terminal strip as shown in Figure 5. Refer to the controller operator's manual for the controller's detector/transmitter's terminal designations. The LEL and oxygen detector channels are direct connect type and the CO channel is 4 - 20 mA transmitter.
7. Connect the drain wire to an available chassis ground at the controller.

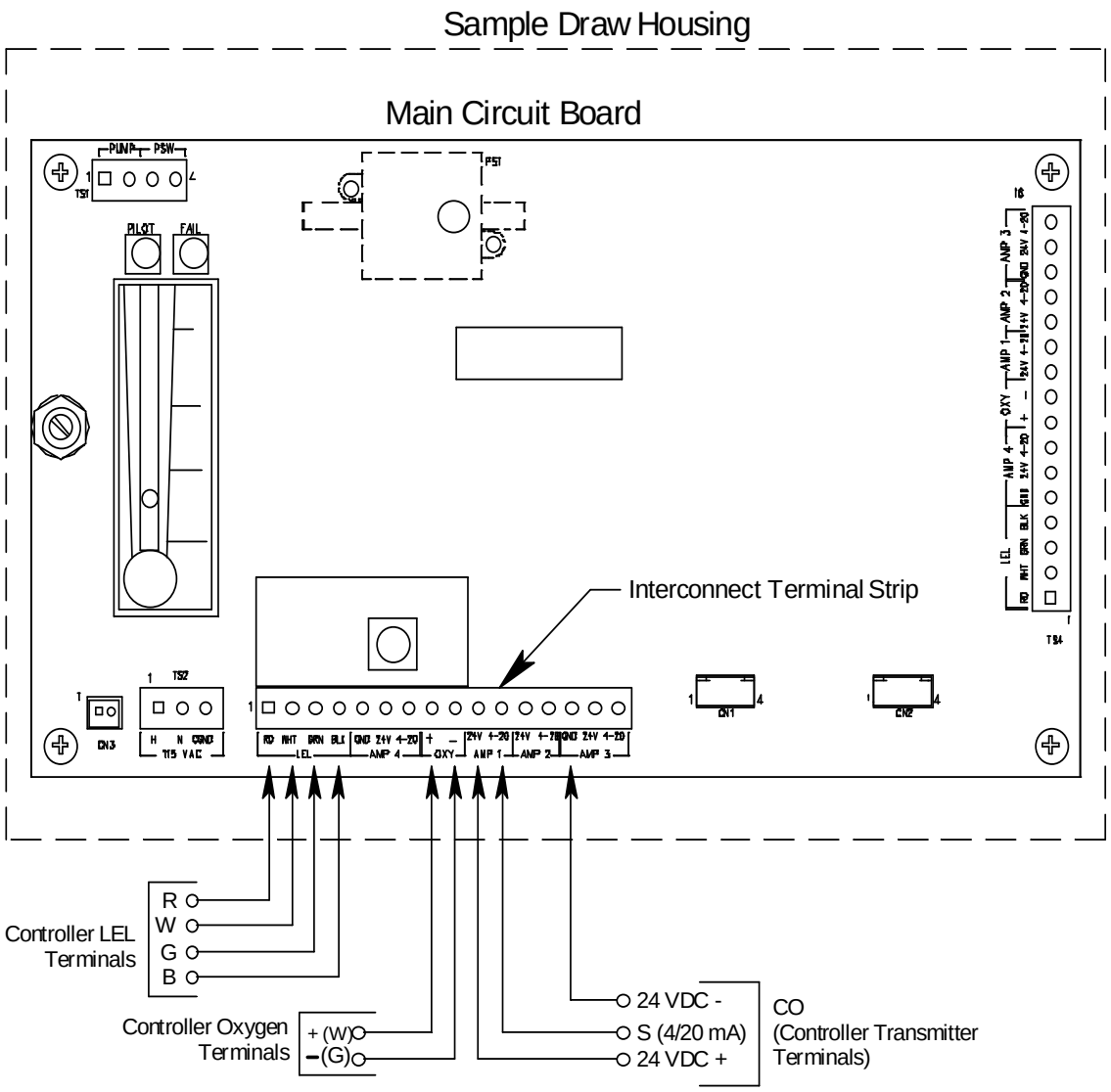

Figure 5: External (field) Wiring, Sample Draw Detector

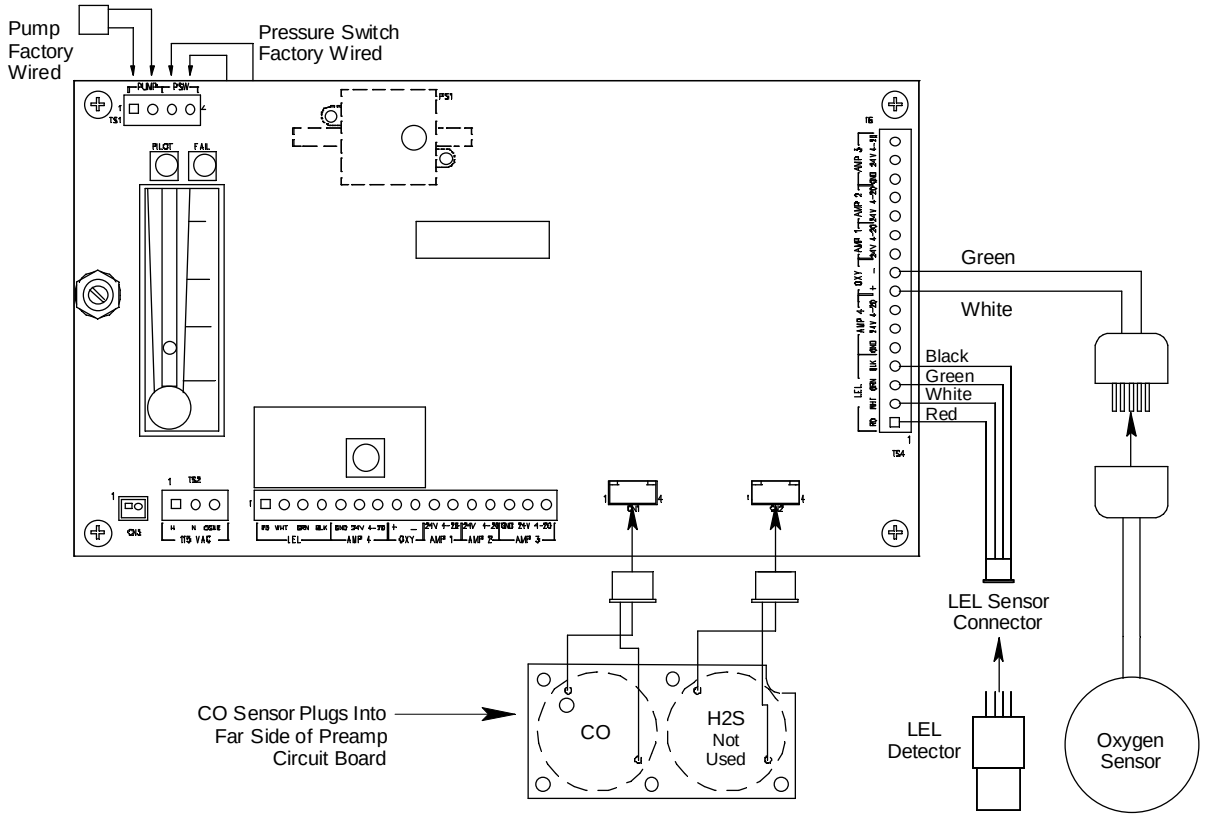

Figure 6: Internal (factory) Wiring, Sample Draw Detector

Start Up

This section describes procedures to start up the sample draw detector and place the sample draw detector into normal operation.

Introducing Incoming Power

1. Complete the installation procedures described earlier in this manual.
2. Verify that the wiring is to the controller is correct and secure.
3. Turn on the controller.
4. Verify that the Pilot LED is on.
5. Verify that the flowmeter indicates a flow rate of approximately 1.2 SCFH. If necessary, use the bypass valve or flow adjust potentiometer to adjust the flow rate.

NOTE: The following step tests for leaks in the sample line. This test will cause a low flow condition which will result in a fail alarm at the controller.

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6. Verify that the incoming sample line is not leaking. To test the sample line, press and hold the pump reset switch to avoid shutting the pump off when a low flow alarm occurs, then plug the open end of the sample line with your thumb. If the open end of the sample line is remote from the sample draw detector, you will need two people to perform this test. If the flowmeter ball drops to the bottom of the flowmeter, the incoming sample line is not leaking.
7. Remove your thumb from the sample line and release the pump reset switch. Verify the flowmeter returns to a normal flow rate and the low flow indication clears.

Setting the Zero Reading

CAUTION: *If you suspect the presence of combustible gas, toxic gases, or an abnormal oxygen condition (not 20.9%) in the monitoring environment, use the calibration kit and the zero air calibration cylinder to introduce "fresh air" to the sample draw adapter and verify an accurate zero setting.*

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1. Verify that the sample draw detector is sampling a fresh air environment (environment known to be free of combustible and toxic gases and of normal oxygen content, 20.9%).
2. Open the housing door.
3. Set a voltmeter to measure in the millivolt (mV) range.
4. Check the zero reading for the CO channel.
   - Plug the voltmeter into the test points in the AMP 1 section of the main circuit board. Plug the positive lead into the test point labeled **CAL+1**; plug the negative lead into the test point labeled **CAL-1**.
   - Verify a voltmeter reading of 100 mV (± 2 mV).
   - If necessary, use a small flat-blade screwdriver to adjust the zero pot until the voltmeter reading is 100 mV (± 2 mV).
5. Verify a reading of 0% LEL on the LEL channel at the controller.

   If the display reading is 0% LEL, the combustible detector is in normal operation.

   If the display reading is not 0% LEL, perform a zeroing operation at the controller. See

the controller operator's manual for instructions.

6. Verify a reading of 20.9% oxygen on the oxygen channel at the controller.

   If the display reading is 20.9% oxygen the oxygen detector is in normal operation.

   If the display reading is not 20.9% oxygen, perform a fresh air adjustment operation at the controller. See the controller operator's manual for instructions.

7. Remove the voltmeter leads from the test points.
8. Close the housing door.

Operation

Normal Operation

During normal operation, the Pilot LED will be on and the flowmeter will indicate about 1.2 SCFH. The current gas readings will be indicated at the controller. See the controller's operator's manual for a description of the reading indications.

Low Flow Alarm

If the flowrate falls below 0.6 SCFH (±0.2 SCFH), then the sample draw detector will initiate a low flow alarm. In a low flow alarm the Fail LED will turn on and the pump will shut off. In addition, the sensor signals to the controller will be interrupted by the sample draw detector resulting in a failure indication for each channel at the controller. If a low flow alarm occurs, press the pump reset switch for about 2 seconds to restart the pump turn off the Fail LED, and resume proper sensor signal transmission to the controller. If the condition continues, find the cause of the reduced flow, correct it, and restart the pump with the pump reset switch. A flow reduction can be caused by a flow blockage, a leak in the flow system, a malfunctioning pressure switch, or a malfunctioning pump.

Maintenance

This section describes maintenance procedures. It includes preventive maintenance procedures. This section also includes procedures to troubleshoot the sample draw detector, replace components of the sample draw detector, and adjust the low flow setting.

Preventive Maintenance

This section describes a preventive maintenance schedule to ensure the optimum performance of the sample draw detector. It includes daily, monthly, and quarterly procedures.

Daily

1. Verify that the Pilot LED is on.
2. Verify that the flowmeter indicates a flowrate of approximately 1.2 SCFH.
   If necessary use the bypass valve or flow adjust potentiometer to adjust the flow rate to 1.2 SCFH.
3. Verify a reading of 0 %LEL for the combustible channel, 20.9% for the oxygen channel, and 0 ppm for the CO channel (100 mV at the amp 1 test points). Investigate significant changes in the reading.

Monthly

This procedure describes a test to verify that the sample draw detector responds properly to the target gases.

Preparing for the response test

CAUTION: *This procedure may cause alarms at the controller. Take appropriate action to avoid this, such as entering the calibration mode at the controller or disabling external alarms.*

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1. Verify that the controller is reading 0 for the combustible and CO channels and 20.9 for the oxygen channel.

   If the reading is not 0 on the combustible or CO channel or 20.9 on the oxygen channel, set the zero reading as described in "Start Up" on page 14, then continue this procedure.

2. Assemble the calibration kit as described in "Assembling the Calibration Kit" on page 20. Use of a 3-gas cylinder is recommended so that all channels may be checked at once.

Performing the response test

NOTE: This procedure describes the RKI calibration kit that includes a gas collection bag. A calibration kit that uses a demand flow regulator is also available.

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1. Fill the gas bag with calibration gas.
2. Connect the calibration tubing from the gas collection bag to the inlet line at or near the INLET fitting.

   The sample draw detector's pump automatically begins pulling the test sample from the gas collection bag when you connect the tubing to the inlet line.

3. After one minute, verify that the reading for each channel at the monitoring device stabilizes within ± 10% of the concentration of the test sample. If the reading is not within ± 10% of the test sample, calibrate the sample draw detector as described in "Calibration" on page 19.
4. Remove the calibration tubing from the inlet line, then reconnect the inlet line.
5. Store the calibration kit in a safe place.

Quarterly

Calibrate the sample draw detector as described in "Calibration" on page 19.

Troubleshooting

The troubleshooting guide describes symptoms, probable causes, and recommended action for problems you may encounter with the sample draw detector.

NOTE: This troubleshooting guide describes sample draw detector problems only. See the controller operator's manual if the controller exhibits any problems.

Sample draw detector fail condition

Symptoms

- The sample draw detector's Fail LED is on.
- The pump is off

Probable causes

- The sample draw detector's flow rate is too low because of an obstructed sample line, failed pump, etc.
- The sample draw detector is malfunctioning.
- The sensor or transmitter wiring is disconnected or misconnected.

Recommended action

1. Verify that the sensor and transmitter wiring is correct and secure. The Installation section on page 10 describes detector wiring connections.
2. Set the correct flow rate with the bypass valve or flow adjust potentiometer.
3. If you cannot set the correct flow rate, check the sample lines for obstructions or kinks.
4. If the fail condition continues, contact RKI Instruments, Inc., for further instruction.

Controller Fail Condition

Symptom

The controller is operating properly but indicates a failure alarm or a reading well below zero on one or more channels.

Probable Causes

- The sample draw detector is in fail condition
- The sensor or transmitter wiring to the controller is disconnected or misconnected.

Recommended Action

1. Check the sample draw detector and if it is in fail, find the cause and correct it (see above).
2. Verify that the sensor and transmitter wiring are correct and secure. The Installation section on page 10 describes detector wiring connections.
3. Calibrate the problem channel or channels as described in the Calibration section on page 19.
4. If the fail condition continues, contact RKI Instruments, Inc. for further instruction.

Slow or no response/difficult or unable to calibrate

Symptoms

- One or more of the sensors respond slowly or does not respond during the monthly response test.
- Unable to accurately set the zero or response reading on one or more on the channels during the calibration procedure.
- One or more of the sensors requires frequent calibration.

NOTE: Under "normal" circumstances, the sample draw detector requires calibration once a quarter. Some applications may require a more frequent calibration schedule.

Probable causes

- The calibration cylinder is low, out-dated, or defective.
- The sample draw detector's flow rate is too low because of an obstructed sample line, failed pump, etc.
- The sample draw detector is malfunctioning.

Recommended action

1. Verify that the calibration cylinder contains an adequate supply of a fresh test sample.
2. If necessary, set the correct flow rate with the bypass valve or flow adjust potentiometer.
3. If you cannot set the correct flow rate, check the sample line for obstructions or kinks.
4. If the calibration / response difficulties continue, replace the sensor as described later in this section.
5. If the calibration / response difficulties continue, contact RKI Instruments, Inc., for further instruction.

Replacing the Sensors

This section includes procedures to replace the sensors.

Replacing the combustible sensor

1. Turn off the controller.
2. Open the housing door of the sample draw detector.
3. Unscrew and remove the two screws that secure the retraining plate, then lift the plate, connector, and sensor out of the housing.
4. Unplug the connector from the sensor.
5. Verify that you are using the correct replacement sensor (NC-6240 is printed on the sensor), then plug the sensor into the connector.
6. Place the sensor in the combustible gas sensor cavity, then position the retaining plate on the two standoffs.
7. Secure the retaining plate to the standoffs with the two screws you removed in step 3.
8. Turn on the controller.
9. Calibrate the replacement sensor as described in the "Calibration" section on page 19.

Replacing the oxygen sensor

1. Turn off the controller.
2. Open the housing door of the sample draw detector.
3. Unscrew and remove the two screws that secure the retraining plate, then lift the plate, connector, and sensor out of the oxygen sensor cavity.
4. Unplug the connector from the socket that leads from the sensor.
5. Plug the socket of the replacement sensor into the connector.
6. Place the sensor in the oxygen sensor cavity, then position the retaining plate on the two standoffs.
7. Secure the retaining plate to the standoffs with the two screws you removed in step 3.
8. Turn on the controller.
9. Calibrate the replacement sensor as described in the "Calibration" section on page 19.

Replacing the carbon monoxide sensor

1. Turn off incoming power.
2. Open the housing door of the sample draw detector.
3. Unscrew the 5 screws that retain the preamp circuit board.
4. Lift the preamp circuit board away from the flow block.

   Be careful not to pull on the cables that connect the preamp circuit to the to the main circuit board.

   There is a foam gasket in the bottom of each flow cavity beneath the circuit board. Make sure the gaskets stay in place.
5. Pull the CO sensor off the preamp circuit board. It is located in the amp 1 position (left side) of the preamp circuit board.
6. Plug the new sensor into the preamp board.
7. Reinstall the preamp circuit board with the sensors onto the flow block.
8. Turn on the controller.
9. Calibrate the replacement sensor as described in the "Calibration" section on page 19.

Adjusting the Low Flow Setting

The factory-set low flow setting is 0.6 SCFH (±0.2). To adjust the low flow setting:

1. Use the flow adjust potentiometer (VR1) to set the flow to 0.6 SCFH.

   If the sample draw detector goes into low flow alarm before you can adjust the flow down to 0.6 SCFH, adjust the low flow potentiometer 1/4 turn clockwise, then attempt to set the flow again. Repeat this step until you are able to adjust the flow to 0.6 SCFH.
2. Slowly turn the low flow potentiometer counterclockwise just until the sample draw detector goes into low flow alarm.

NOTE: The low flow potentiometer is accessible through a circular cutout in the main circuit board. The cutout is labeled PS1.

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3. Verify that the low flow alarm is 0.6 SCFH (±0.2). Repeat steps 3 and 4 if necessary.
4. Use the flow adjust potentiometer (VR1) to set the flow to 1.2 SCFH.
5. Make sure the sample draw detector's Fail LED is off.

Calibration

This section describes how to calibrate the sample draw detector. It includes procedures to assemble the calibration kit, set the zero reading for each channel, set the response reading for each channel, and return to normal operation.

NOTE: This procedure describes calibration using a gas collection bag and a 3-gas calibration cylinder. A demand-flow regulator calibration kit is also available for calibrating the sample draw detector.

Preparing for Calibration

CAUTION: *This procedure may cause alarms at the monitoring device. Take appropriate action to avoid this, such as entering the calibration mode at the monitoring device.*

1. Open the housing door.
2. Set a voltmeter to measure in the millivolt (mV) range. It will be used in the calibration of the CO channel.

   When checking the mV output of the CO channel, plug the voltmeter leads into the test points in the AMP 1section of the main circuit board. Plug the positive lead into the test point labeled **CAL+1**; plug the negative lead into the test point labeled **CAL-1**.
3. Use the following formula to determine the correct test points output for the CO calibrating sample.

   Output (mV) = (calibrating sample/fullscale) X 400 + 100

   For example, with a calibrating sample of 50 ppm CO and a fullscale setting of 300 ppm CO, the correct output for the CO test points is 167 mV.

   200 (mV) = (50/300) X 400 +100

Assembling the Calibration Kit

NOTE: If you can verify a fresh air environment, it is not necessary to use a zero air calibration cylinder to set the zero reading. Perform Step 1 and then proceed to the next section, “Setting the Zero Reading” .

1. Connect the calibration kit sample tubing with the tubing clamp to the fitting on the gas collection bag.
2. Connect the sample tubing from the gas collection bag to the inlet line at or near the INLET fitting.

   Allow the sample draw pump to draw out any residual gas in the gas collection bag.
3. Disconnect the calibration kit sample tubing from the inlet line.
4. Close the clamp right away. The clamp is attached to the calibration kit sample tubing.
5. Connect the tubing from the gas collection bag to the fixed flow regulator, then open the clamp.
6. Screw the fixed flow regulator onto the zero air calibration cylinder.
7. Turn the on / off knob on the regulator counterclockwise to open it. The gas collection bag begins to fill.
8. When the bag is full, turn the on / off knob on the regulator clockwise to close it.
9. Close the clamp, then disconnect the sample tubing from the fixed flow regulator.
10. Unscrew the fixed flow regulator from the cylinder.

Setting the Zero Reading

1. Open the clamp, then connect the sample tubing from the gas collection bag to the sample draw detector’s inlet line. **This step is not necessary if you verified a fresh air environment earlier in this procedure.**
2. Allow the reading to stabilize for 1 minute.

3. Verify a voltmeter reading of 100 mV ± 2 mV at the AMP 1 test points for the CO channel as described in the Preparing for Calibration section above.
4. If necessary, use a small flat-blade screwdriver to adjust the zero pot for the CO channel until the voltmeter reading is 100 mV ± 2 mV.
5. The zero (fresh air) readings for the LEL and oxygen channels are set at the controller. See the controller operator's manual for instructions to set the zero readings.
6. Connect the sample tubing from the sample bag to the sample draw detector's inlet line at or near the sample draw detector's INLET fitting.
7. Allow the sample draw pump to draw out any residual gas in the gas collection bag.
8. Disconnect the sample tubing from the inlet line, then close the clamp.
9. Connect the sample tubing from the gas collection bag to the fixed flow regulator, then open the clamp.
10. Screw the fixed flow regulator onto the calibration gas cylinder.
11. Turn the on / off knob on the regulator counterclockwise to open it. The gas collection bag begins to fill.
12. When the bag is full, turn the on / off knob on the regulator clockwise to close it.
13. Close the clamp, then disconnect the sample tubing from the fixed flow regulator.
14. Unscrew the fixed flow regulator from the cylinder.

Setting the Response Reading

1. Open the clamp, then connect the sample tubing from the gas collection bag to the inlet line at or near the sample draw detector's INLET fitting.
2. Allow the sample draw detector to respond to the calibrating sample for 1 minute.
3. Check the mV output on the AMP 1 test points for CO and verify that the reading matches the response reading (±2 mV) you determined earlier.
4. If necessary, use the AMP 1 span pot to adjust the reading to match the correct response reading.
5. Remove the voltmeter leads from the test points.
6. Follow the directions in the controller's operator's manual for setting the response reading for the LEL and oxygen channels. Note that if you use a 3-gas mix, the response reading for oxygen will be set using something other than 0% oxygen, typically 12.0% oxygen.
7. Allow the sample draw pump to draw out any residual gas in the gas collection bag.
8. Disconnect the sample tubing from the sample draw detector's inlet line.
9. Reconnect the incoming sample line.
10. Wait 1 to 2 minutes to allow the calibration gas to be drawn out and the readings to stabilize.
11. Store the components of the calibration kit in a safe and convenient place.

Parts List

Table 2 lists replacement parts and accessories for the sample draw gas detector.

Table 2: Parts List

Part Number	Description
06-1248RK	Sample tubing, 3/16 x 5/16, specify length, (for calibration kit)
07-0034RK	Sealing gasket, for CO and flow block cavities
30-0610RK	Pump
33-0171RK	Hydrophobic filter (AcroPak)
33-6095RK	Charcoal filter, CF-188
61-0145RK	Combustible sensor
65-0601RK	Oxygen sensor
81-0076RK-03	Zero air calibration cylinder (103 liter)
81-0090RK-03	3-gas calibration gas cylinder, 50% LEL methane/12% oxygen/50 ppm CO, 103 liters
81-1051RK-60	Regulator, w/gauge and knob, fixed flow, 6 LPM
81-1126RK	Gas collection bag (2 liter)
ES-1531-CO	CO sensor