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Carbon Monoxide Sensors
and Atmospheric
Monitoring Systems
Inspection Procedures

PREFACE

This handbook sets forth procedures for inspections of automatic fire sensor and warning device systems using carbon monoxide sensors and atmospheric monitoring systems. Previously issued procedural instruction letters and administrative instructions and handbooks for this subject material are superseded by this handbook. Compliance related policies that are contained in the Mine Safety and Health Administration (MSHA) Program Policy Manual are not superseded by this handbook.

This handbook provides general guidance consistent with the requirements of the Federal Mine Safety and Health Act of 1977 (Mine Act) as amended by the Mine Improvement and New Emergency Response (MINER) Act of 2006. Inspectors should recognize that not all procedures and requirements are applicable for all mine types. Any deviation from the procedures outlined in this handbook should be based on the inspector's professional judgement, and discussion with the inspector's supervisor.

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CHAPTER 1 – INTRODUCTION

A. Purpose

This revised handbook sets forth procedures for inspection of atmospheric monitoring systems (AMS) and automatic fire sensor and warning device systems conducted by MSHA.

An AMS is a network consisting of hardware and software meeting the requirements of §75.351 or §57.22301. An automatic fire sensor and warning device system is a network consisting of hardware and software meeting the requirements of §75.1103-4. Both are capable of measuring atmospheric parameters; transmitting the measurements to a designated surface location; providing alert, alarm, or warning signals; and processing atmospheric data. An AMS system meeting the requirements of §75.351 would satisfy the requirements of an automatic fire sensor and warning device system under §75.1103-4. However, an automatic fire sensor and warning device system may not satisfy the requirements of an AMS system.

Chapter 2 contains pre-inspection guidance and lists the information and documentation enforcement personnel need for inspection activities. Chapters 3 and 4 discuss details of evaluating parameters and functions of AMS and automatic fire sensor and warning device systems required by health and safety standards, granted petitions for modification (PFM), Emergency Response Plans (ERP), and mine ventilation plans. Chapter 5 discusses appropriate responses to alarms and other observed signals. Chapter 6 lists items to verify when inspecting at MNM mines. Appendix A discusses details for evaluating outstations when they are used.

Examples included in this handbook are provided for clarification purposes.

B. Authority

Enforcement authority depends on the purpose of the installation. An AMS may be required under: §57.22301 to monitor methane in mine atmospheres; §75.323(d)(1)(ii) to monitor for methane in the return split alternative; §75.340(a)(1)(ii) and (a)(2)(ii), to monitor intake air used to ventilate electrical installations; §75.350(b) to use air from the belt entry to ventilate working sections or areas where mechanized mining equipment is being installed or removed; §75.350(d), to monitor point-feed regulators; or §75.362(f), to continuously monitor for methane in return splits. Where an AMS is used to meet the above requirements, the AMS must meet the requirements contained in §§75.350, 75.351, and 75.352.

An automatic fire sensor and warning device system that uses carbon monoxide sensors to provide identification of fire along belt conveyors as required by §75.1103-4 must meet the requirements contained in §§75.1103-1 through 75.1103-8.

Additional details of the system may be contained in the approved mine ventilation plan.

The Approval and Certification Center (A&CC) evaluates AMS and automatic fire sensor and warning device systems to ensure that the electric circuit feeding the sensors will not ignite methane. Components installed in areas where permissible equipment is required must be intrinsically safe or in explosion-proof enclosures. Systems evaluated and accepted by A&CC must be installed and maintained as evaluated.

CHAPTER 2 - PRE-INSPECTION PREPARATION

Prior to traveling to a mine to inspect an Automatic Fire Sensor and Warning Device System or AMS, an inspector can review the following regulatory documents as well as Plans generated by the mine operator.

Review the following:

1. Applicable Standards
2. Applicable PFMs

Review the content of the following and compare with applicable Automatic Fire Sensor and Warning Device System or AMS regulations, and PFM provisions to ensure these documents are valid and up to date prior to inspection:

1. Training Plan
2. Ventilation Plan, including any available maps or schematics of the system
3. Mine Emergency Evacuation and Firefighting Program of Instructions
4. Emergency Response Plan (ERP)
5. System manufacturer documentation if available

CHAPTER 3 - SURFACE INSPECTIONS

A. Mine operator's records and postings.

Check the mine operator's records and postings for compliance with the following:

1. Calibration of carbon monoxide (CO) Sensors – conducted and recorded in accordance with §§75.351(n), 75.351(o), and 75.351(p) or 75.1103-8(c). Calibration records should identify the date of each sensor calibration. The sensor address or identifying number must be specified in the calibration record. For example, “sensor numbers 71, 72, 73, 74, 75 and 76 calibrated on 05-21-2019” would be acceptable;
2. Examination and testing as per §§75.351(n), 75.351(o), 75.1103-8(a), and 75.1103-8(b); and
3. Designation and training of AMS operators and other appropriate personnel as per §§75.351(b)(4) and 75.351(q).

B. Mine maps or schematics.

Check for accurate and up-to-date mine maps or schematics at designated surface locations. Verify maps and schematics are consistent with §§75.351(b)(3), 75.372, and 75.1103-5.

NOTE: The underground inspection of the system can be facilitated by obtaining a hard copy of the map or schematic. If a copy is not available, the inspector should draw a line schematic of the system for the areas where travel is anticipated.

C. Operation of the system.

1. Check video display terminal for the following:
 - a. All outstations and sensors are scanned by the system (compare with map or schematic showing location of sensors). Determine the operational status of the sensors. Sensors indicating communication failures should be noted and examined during underground inspection.
 - b. Abnormal levels, high or low, in sensor readings. These levels may indicate a sensor calibration drift or a sensor beginning to fail. Abnormal readings may also indicate the actual level of the gas being monitored. If there is any abnormality, ensure that the system operator is aware of it and is following the appropriate procedures.

- c. The sensor levels indicated on the display terminal are stable and are not fluctuating over a wide range each time a sensor is scanned. Erratic readings are not normal and may indicate a malfunctioning sensor. Note the locations of sensors with abnormal or erratic readings for follow-up during the inspection.
 - d. Ensure that the CO readings shown on the display reflect the established ambient level in the Ventilation Plan.
 - e. Determine that malfunctions, alerts, alarms, warning signals or other action levels are indicated on the surface display when a sensor is activated.
2. Check that alarm records are consistent with §§75.351(o), 75.340(a)(1)(ii), and 75.352.

Where possible, evaluate the number of alarms caused by sensor or system malfunction, or interfering gasses (such as hydrogen) that may impair the function of CO sensors. Where interference has been established, have the mine operator replace the impaired sensors with ones designed to compensate for the interfering gas. Also, evaluate the number of alarms caused by CO produced by diesel engine exhaust. Where alarms are frequently caused by diesel exhaust, discuss with the District Manager, who may require the use of diesel-discriminating sensors in the mine ventilation plan. Additionally, check for the following:

- a. Records of abnormal readings. Records representing an extended period of time can be used to detect abnormalities;
 - b. Records showing communication failures between the sensors and computer;
 - c. The number of sensors indicated in the record is consistent with those specified on the map or schematic;
 - d. AMS records for malfunctions, maintenance, alerts, alarms, and action level readings; the cause for activation; and corrective action taken. These records should include alert and alarm reports from personnel monitoring the belt entry with a CO detector during system malfunction.
3. Determine and evaluate the means of de-energizing the monitoring system during a main mine fan stoppage ("kill feature"). The "kill feature" is the means of de-energizing non-permissible battery-powered circuits from a surface location. In some monitoring systems, the de-energization of the outstations can be accomplished from the main console on the surface and

observed on the monitor screen or digital readout. After the "kill feature" has been initiated, all batteries must be manually reset at each underground battery location after power has been restored to the fan. The method used to de-energize the underground batteries can be determined by examination of the system operator's station; this may be an automatic action or it may require input from the system operator. The system operator should be able to explain the "kill feature." A system with battery backup power supplies that cannot be disconnected remotely from the surface must be intrinsically safe or be provided with means, such as a relay, to disconnect the battery power supply. A manually operated switch actuated by a miner leaving the section is not an acceptable means to disconnect the batteries.

4. Obtain a copy of the installation and maintenance check-list provided by the manufacturer to the mine operator. A copy of the check-list can also be requested from A&CC for any MSHA-evaluated systems. Inspectors can use the equipment manufacturers' installation and maintenance check-lists to familiarize themselves with system operation and aid in the inspection and testing of the system.
5. Verify that the system operator is properly trained as per §75.351(q).
6. Verify notifications are provided per §75.1103-5(g).

D. Visual and audible alarms on the surface.

Verify locations of alarms and duties of the system operator are consistent with §§75.351(c) and 75.1103-5(a).

E. Communication system between the surface and underground.

Two-way communication system requirements are addressed by the approved ERP. Communication systems that are installed in accordance with the approved ERP will be considered to meet the requirements of §75.351(r).

F. Lightning arrestors.

Verify lightning arrestors are installed as per §75.521.

CHAPTER 4 - UNDERGROUND INSPECTIONS

A. Direction of air flow in belt entries

Verify that underground conditions are consistent with air flow directions indicated on the surface map or schematic, in accordance with §§75.351(b)(3) and 75.1103-5(a)(2)(ii), and comply with the ventilation plan.

B. Air velocities in belt entries

1. For automatic fire sensor and warning device systems that use carbon monoxide sensors to provide identification of fire along all belt conveyors, verify that the air velocities are at least 50 feet per minute (fpm) along all belt conveyors unless a lower velocity is approved in the mine Ventilation Plan. Verify that the sensor spacing is not greater than 350 feet in areas where the air velocity is less than 50 fpm. For AMS, verify that the air velocity is at least 100 fpm. In areas where lower velocities are approved in the Ventilation Plan, assure sensor spacing is compatible with the air velocity (not greater than 350 feet in areas where the air velocity is less than 50 fpm, not greater than 500 feet where the air velocity is between 50 and 100 fpm). A system is considered to be inoperative if the air velocity is less than 100 fpm for AMS or where the velocity is less than 50 fpm for automatic fire sensor and warning device systems and the sensor spacing has not been reduced. The system would be operative once the air velocity is re-established or decreased sensor spacing is approved and established.
2. Verify that the air velocities are no greater than the maximum allowable velocities (1000 fpm for mines using air from the belt entry to ventilate a working section). If air velocities are higher than 500 fpm, dilution of the fire contaminants that affect the fire detection capabilities may occur. Generally, velocities less than 500 fpm, but greater than 50 fpm, should not be a concern.
3. When determining air velocities, representative cross-sectional areas of the entries should be used. Large areas such as belt channels, boom holes or fall areas should not be used, nor should restricted areas such as overcasts be used for determination of air velocities.

C. Verify mine maps are located as required

Mine maps are required at working sections, refuge alternatives, and where equipment is being installed or removed.

D. Installation of AMS communication system

Two-way communication system requirements are addressed by the approved ERP. Communication systems that are installed in accordance with the approved ERP will be considered to meet the requirements of §75.351(r).

E. Installation of sensors and cables

Verify that CO and methane sensors and cables are installed properly, per the diagrams below.

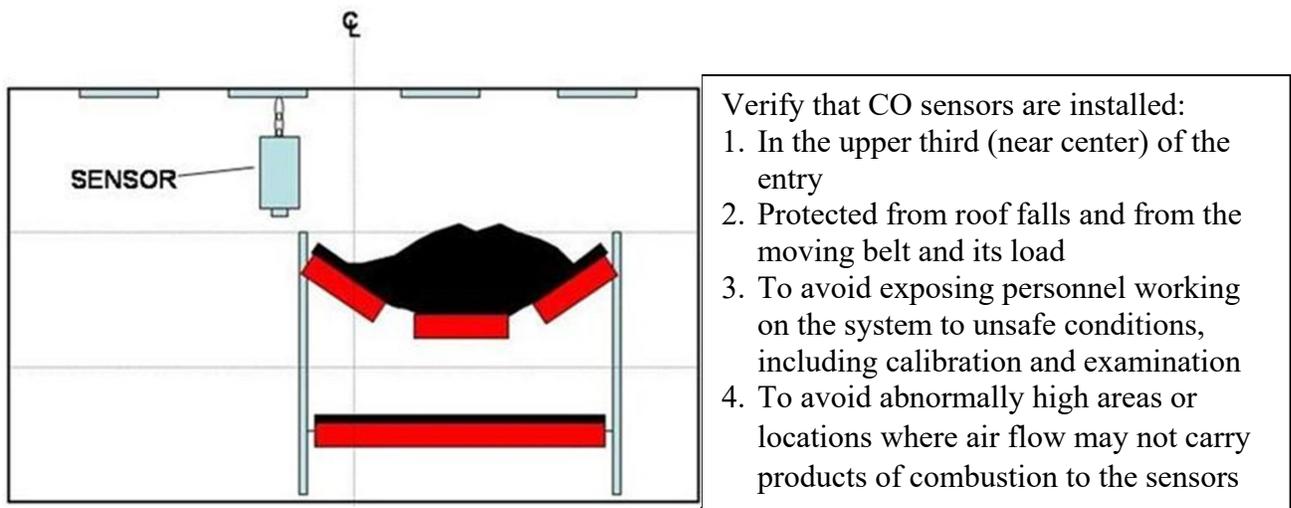


Figure 1 - Proper Location of CO Sensor



Verify that methane sensors are installed near the center of the entry, at least 12 inches from the roof, ribs, and floor in a location that would not expose personnel working on the system to unsafe conditions.

Figure 2 - Properly Installed Methane Sensor

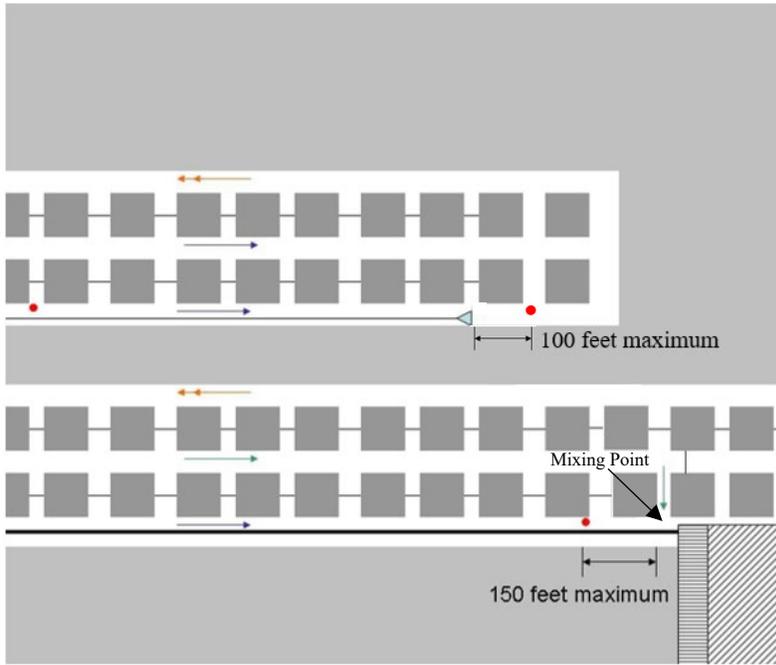
F. Location of sensors

Determine if additional sensors are required. If during an inspection it is determined that additional sensors are needed to fully monitor the belt entry for fire, the concern should be discussed with the field office supervisor or ventilation specialist for further action.

Determine if the sensors are installed as shown on the map or schematic located at the designated surface location. Check the locations and types of sensors at each of the following areas:

1. Belt Entries

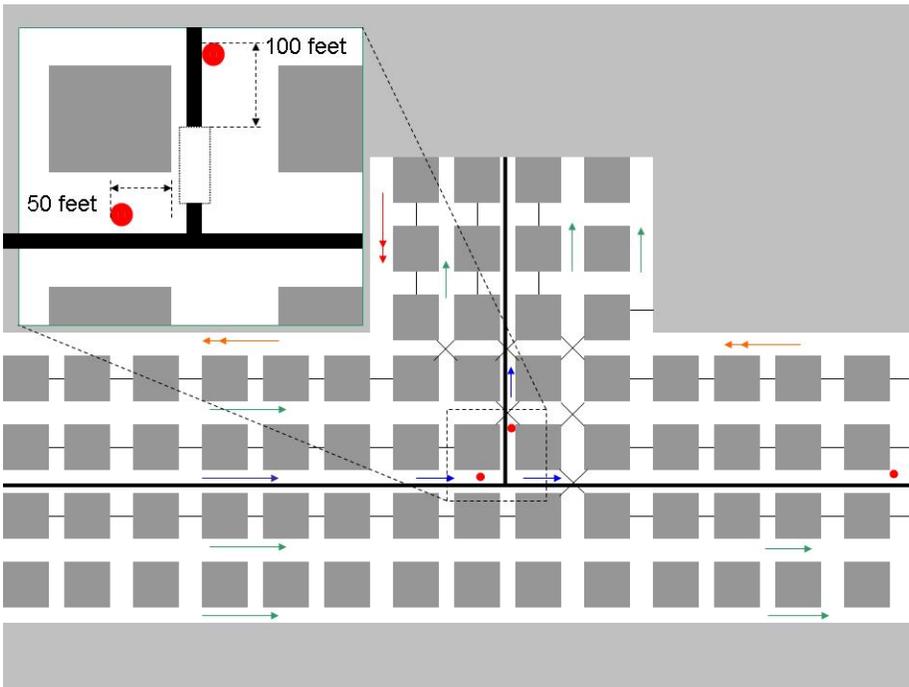
Verify sensors are installed at all locations specified in the Ventilation Plan, PFM, and §§75.351(e) and 75.1103-4 as applicable:



For automatic fire sensor and warning device systems using CO sensors to identify a fire along belt conveyors, a sensor is required within 100 feet downwind of each section loading point.

For AMS, at or near the working section belt tailpiece in the air stream ventilating the belt entry. In longwall mining systems using air from the belt entry to ventilate the section, the sensor must be located upwind in the belt entry at a distance no greater than 150 feet from the mixing point where intake air is mixed with the belt air at or near the tailpiece.

Figure 3 - Sensor Installations near Section Loading Point



Upwind, a distance no greater than 50 feet from the point where the belt air course is combined with another air course or splits into multiple air courses.

Not more than 100 feet downwind of belt drive.

Figure 4 – Location of Required CO Sensors at Air Split and Belt Drive

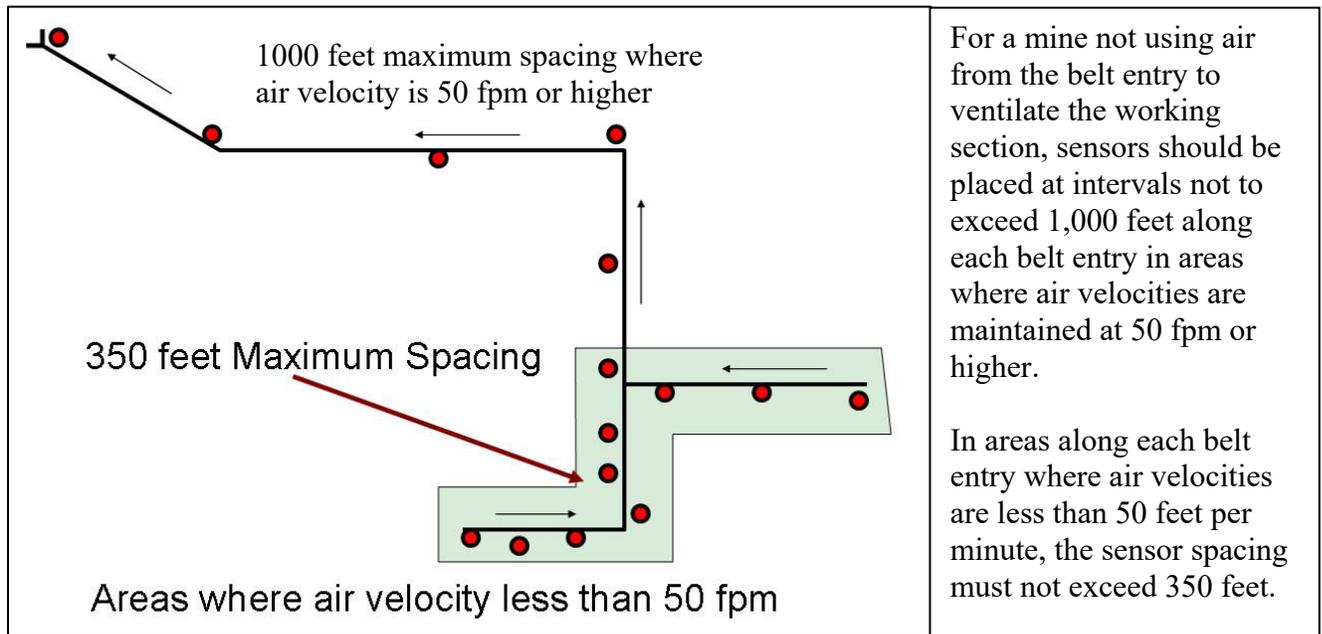


Figure 5 - Sensor spacing (Mine not using air from belt entry to ventilate working sections)

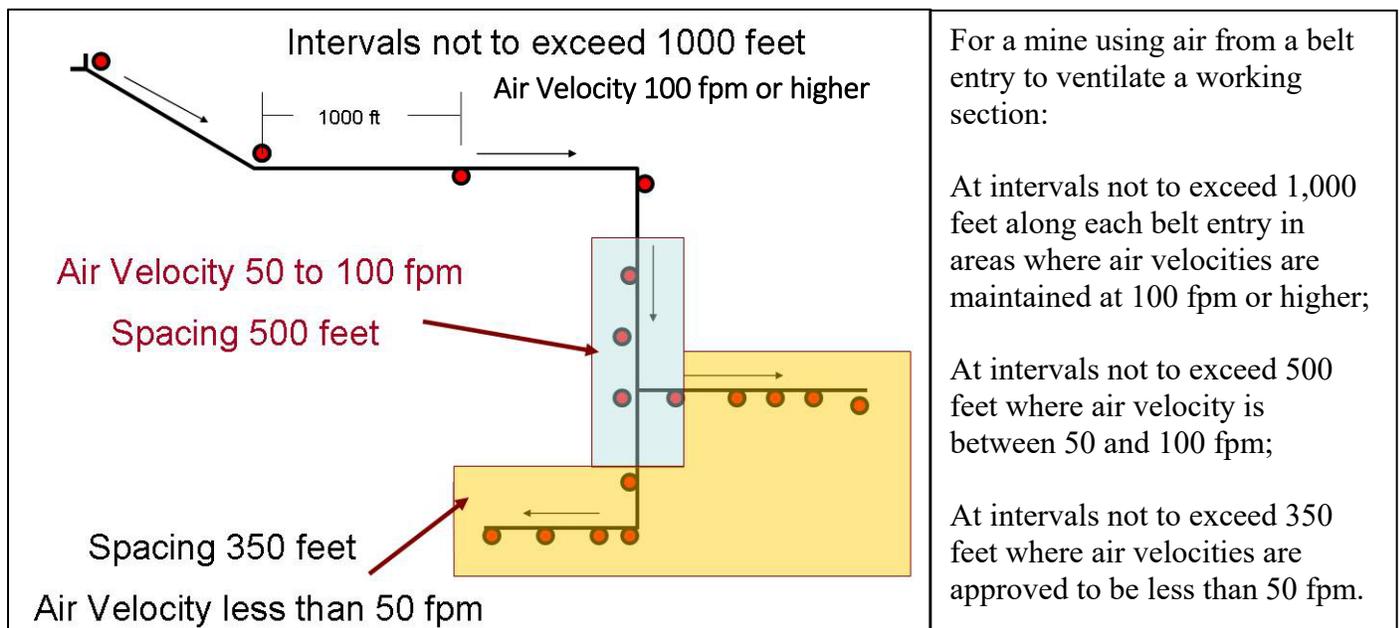


Figure 6 - Sensor Spacing (Mine using air from belt entry to ventilate working sections)

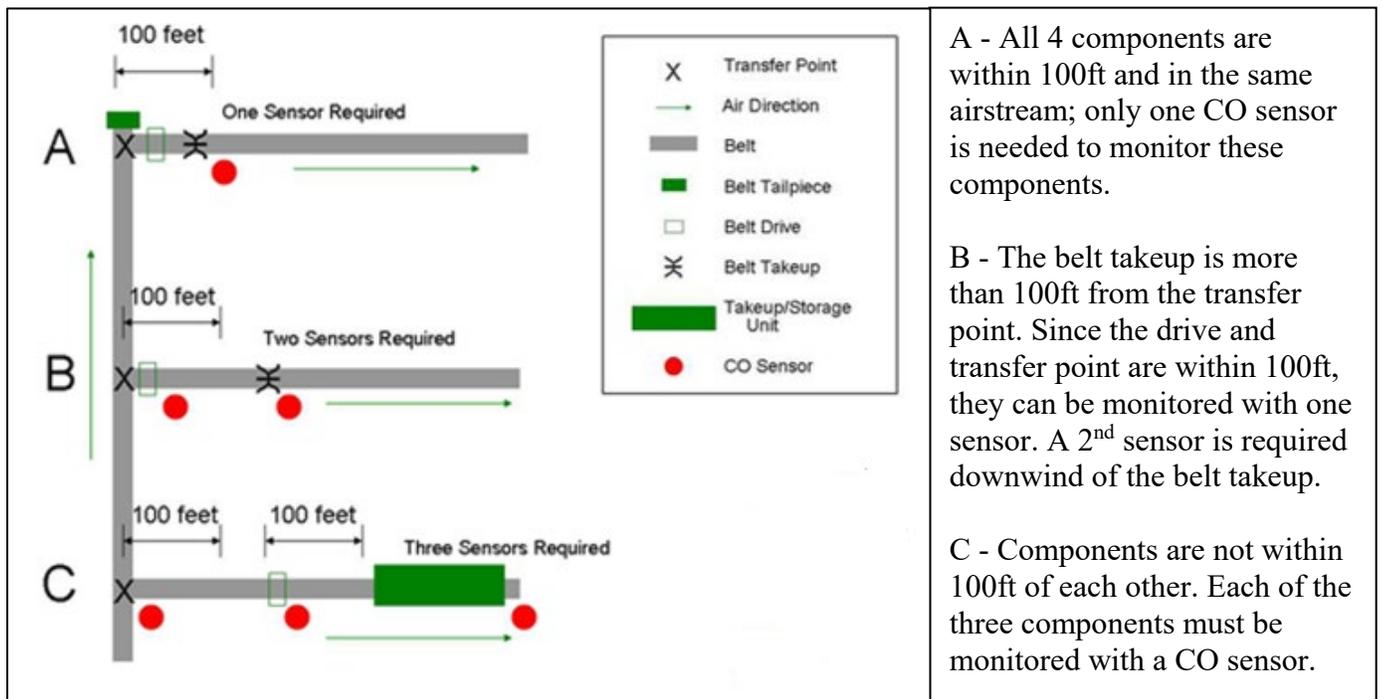


Figure 7 - Sensors Required at Belt Drives - Multiple Components

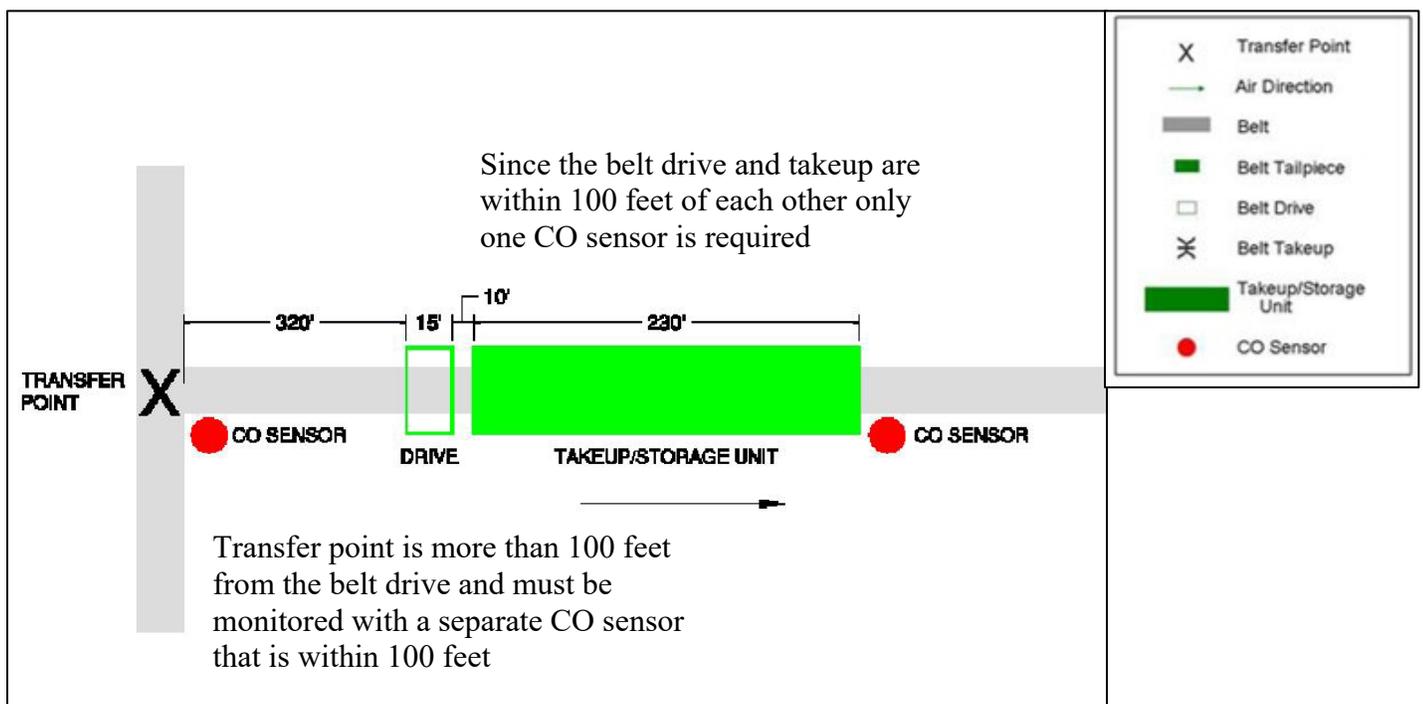


Figure 8 - Sensors Required at Belt Drives - Multiple Components

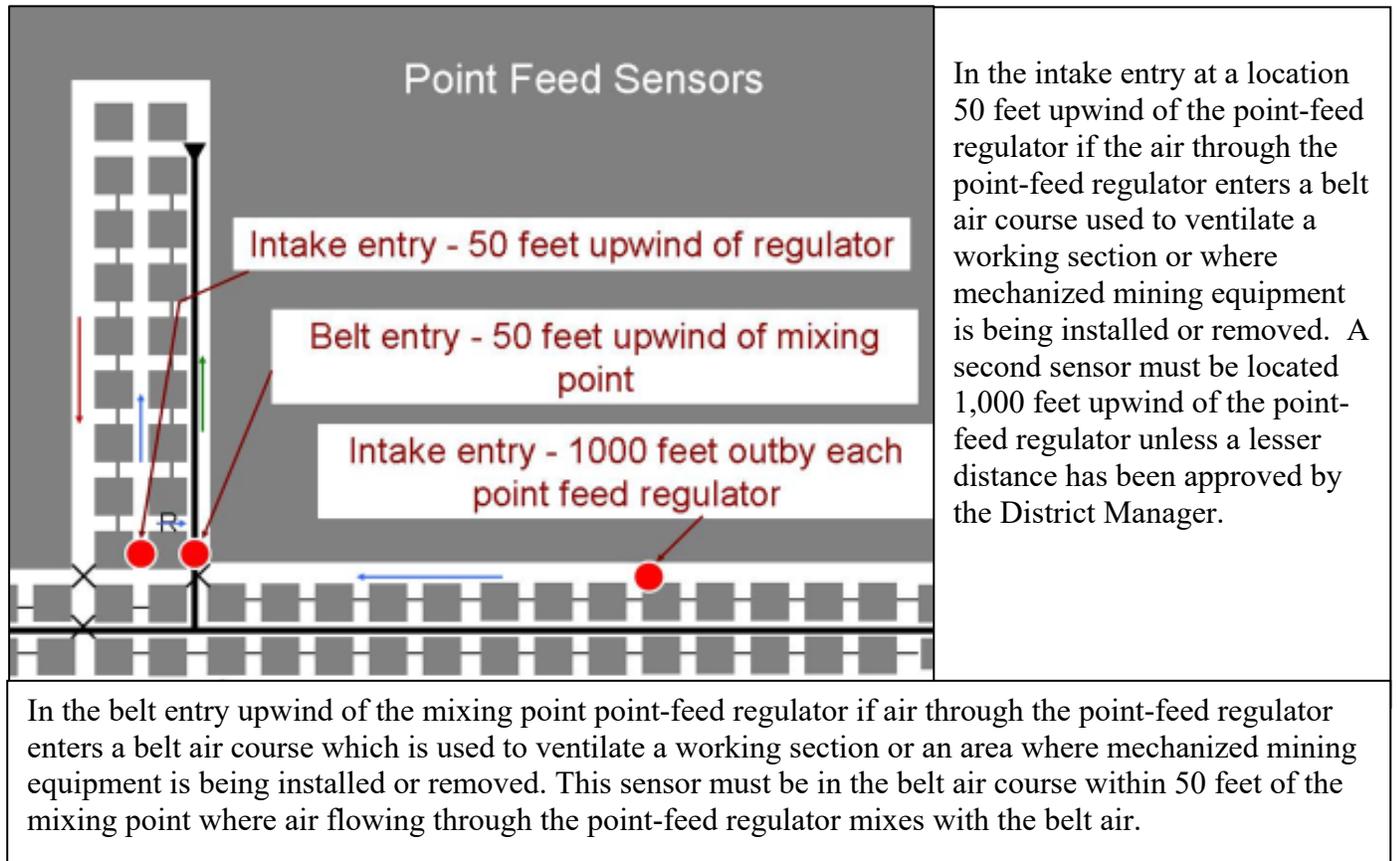


Figure 9 - Point-feed regulator and CO sensor locations

2. Primary Escapeways

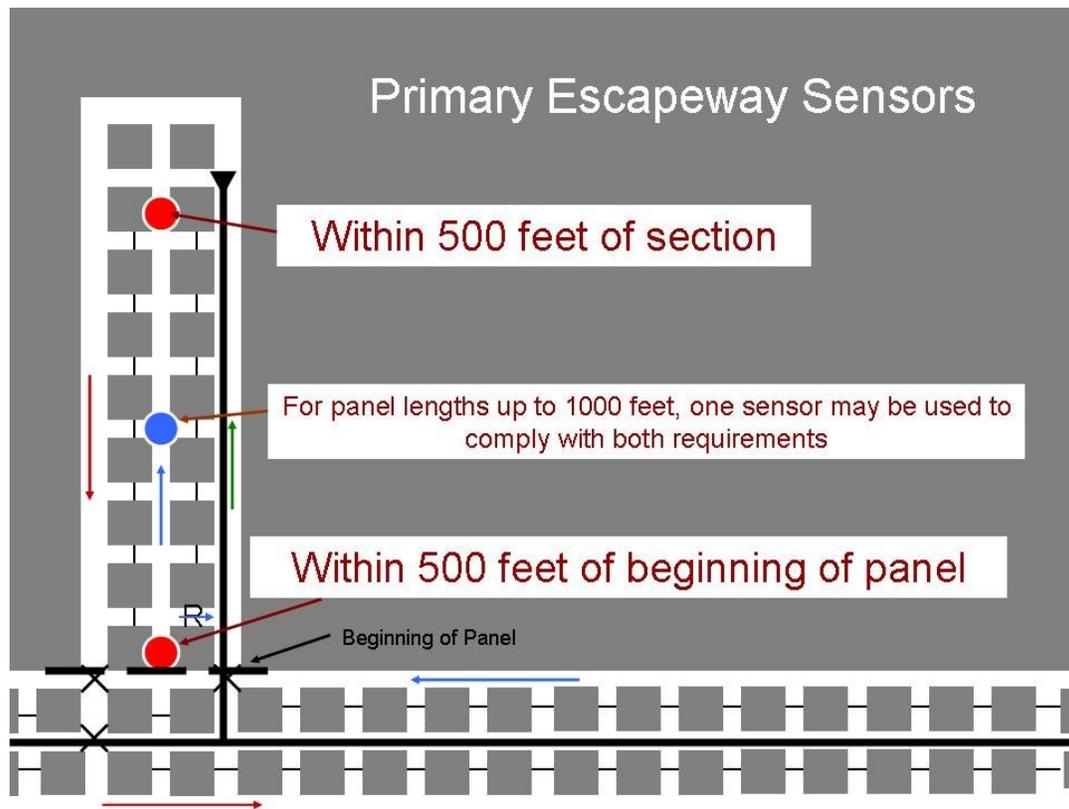


Figure 10 - Primary escapeway sensor locations – Mines using air from belt entry to ventilate working sections

3. Return Air Splits

- a. If an AMS is used to monitor return air splits to comply with on-shift requirements, verify that a methane sensor is installed in the return air split per the requirements of §75.351(g)(1).
 - b. If sensors are used to monitor a return air split for excessive methane, verify that the sensors are installed in the return air course per the requirements of §75.351(g)(2).
4. When monitoring the intake air that ventilates underground electrical installations under §75.340(a)(1)(ii) or §75.340(a)(2)(ii), verify that at least one sensor is located per the requirements of §75.351(h). Sensors that are not affected by hydrogen must be used to monitor the intake air that ventilates battery charging stations.

5. Electrical Installations

When sensors are used to monitor unattended air compressors, the sensors must comply with the requirements of §75.344(a)(2).

6. Intake Air Heaters

When CO sensors are used to monitor intake air heaters, verify that any heater causing an elevated CO level is shut down automatically when the concentration at the monitoring location reaches 50 parts per million (ppm) per §75.341(f).

G. Inspection/Calibration of CO sensors

Before inspection or calibration of CO sensors, the inspector should have the agent of the mine operator notify the system operator that sensors will be inspected, calibrated, and checked for malfunctions. The system operator should verbally confirm the time and location of each alert, alarm, and malfunction signal, as applicable, when received.

1. Visually check sensors for blockage of airflow to assure that airflow patterns within the belt entry are not obstructed by objects such as cribs and posts that may interfere with contaminants reaching the sensors.
2. Check the sensor, the cable, and hose to the sensor for visible damage.
3. Compare sensor readings with hand-held CO detector readings.
4. Have the agent of the mine operator simulate a malfunction at the sensor unit. Verify that malfunctions for AMS are recorded at the designated surface location. A disconnection of wiring at the sensor unit that results in failure of the system is considered a malfunction.
5. Ensure that sensors and associated current-carrying conductors installed where permissible equipment is required, have been evaluated by MSHA. Verify that the sensors are identified by an MSHA classification label, and that the barrier located at the blue outstation to protect the sensor circuit is also identified by an MSHA classification label that has same letter designation as the sensor classification.
6. Ensure that calibration gas is of sufficient concentration to activate all alarms. Sensors should respond within plus or minus 10% of the known concentration of the calibration gas.

7. Observe a function test of 10% of the total number of CO sensors, but not less than 5 sensors, using a known concentration of CO. Record the test reading and compare it to the known gas concentration.
8. Observe the calibration of at least one CO sensor to ensure that the manufacturer's guidelines for calibration are followed. Some systems have a means to temporarily bypass the sensor during calibration to avoid false alarms. This feature should be used when available.

H. Section alarms

Ensure that alarm units are located at all working sections, affected areas where mechanized equipment is being installed or removed, at other specified locations (Evacuation Plan, granted PFM, and Ventilation Plan), and at a manned location on the surface. Examples of alarm units are shown in Figure 11.

Note: The carbon monoxide sensor can be up to 100 feet away from the section loading point for an automatic fire sensor and warning device system, but the alarm unit should be located to provide an effective warning signal. An AMS is required to have the sensor located at or near the section belt tailpiece.

1. Verify the following:
 - a. Alarm units located in areas where permissible equipment is required (inby the last open crosscut, within 150 feet of pillar workings or longwall faces, or in return air) have a LTR classification label attached.
 - b. Power and data cables for the alarm units originate from a blue outstation through a LTR barrier with a classification identical to the LTR classification of the alarm unit.
 - c. An alarm unit has been installed in the belt entry to provide a signal at the locations specified in §75.352(g) when carbon monoxide concentrations reach alert or alarm levels.
 - d. Alarm units are located where they can be seen or heard by miners as required by §75.351(c) or §75.1103-5 when
 - i. An alarm or warning condition exists for CO or methane. Methane signals for an AMS are distinguishable from other signals; and
 - ii. Two consecutive sensors in the belt entries alert at the same time.



Figure 11 - Examples of alarm units.

Note: The signal is required to be seen or heard by at least one miner. If none of the miners on a working section can see or hear an alarm while mining, the alarm unit or its location is not effective.

2. Check the section alarm by requesting that a representative of the operator apply calibration gas to an outby CO sensor to activate it.
 - a. Ensure that the system is programmed to activate section alert and alarm signals or warning signals as specified in §75.351(i) or §75.1103-5 or approved plans.
 - b. Verify that section alarms and warning signals are indicated in all affected areas as required in §75.351(c) or §75.1103-5.
3. Examine alarm units to determine that the visual alarm indicator and audible alarm speaker are clear of obstructions.
4. Check for proper installation of internal batteries. See Figure 12.

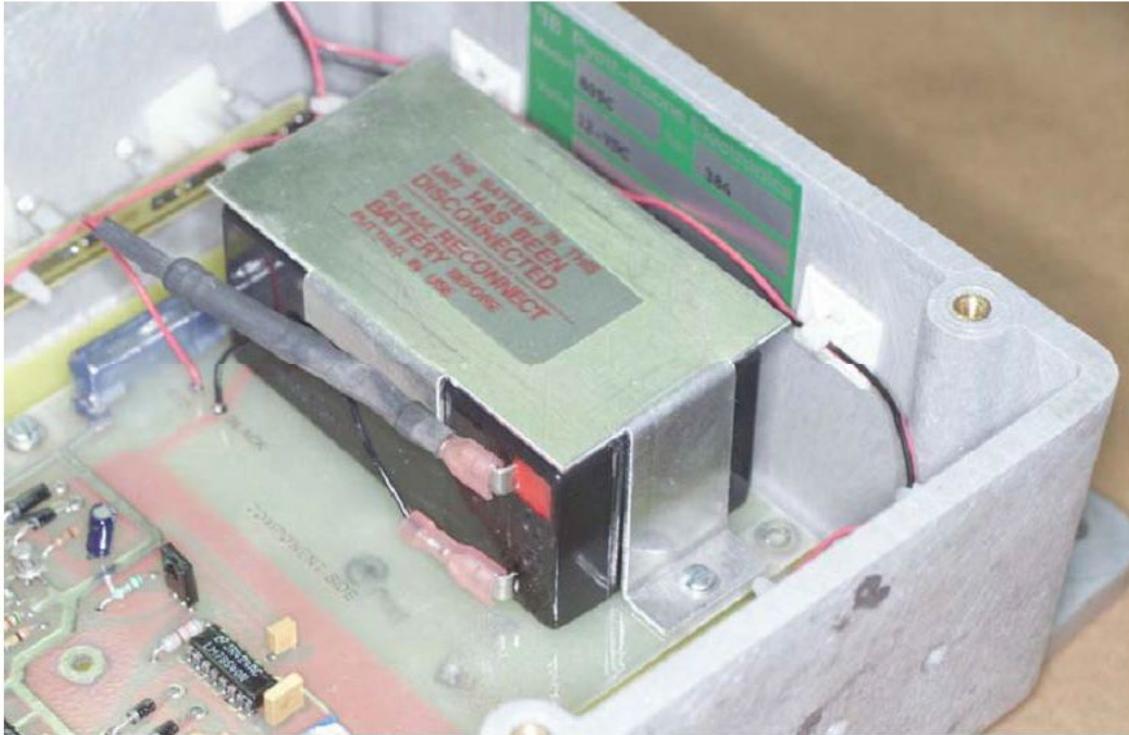


Figure 12 - Example of Properly Installed Battery.

I. Determining affected working sections; affected areas.

Alert, alarm, or warning signals for carbon monoxide must be provided automatically to working sections and at other locations as specified in the Mine Emergency Evacuation and Firefighting Program of Instruction and other locations required by §75.351(c) or §75.1103-5.

To identify locations where miners may be endangered, consider the following factors: location of the sensor with respect to work areas; ventilation (the direction of air) in the belt entry; and escapeway designation. The following diagrams (Figures 13 - 17) are provided as guidance in determining areas that could be affected by an activated sensor in the event of a fire.

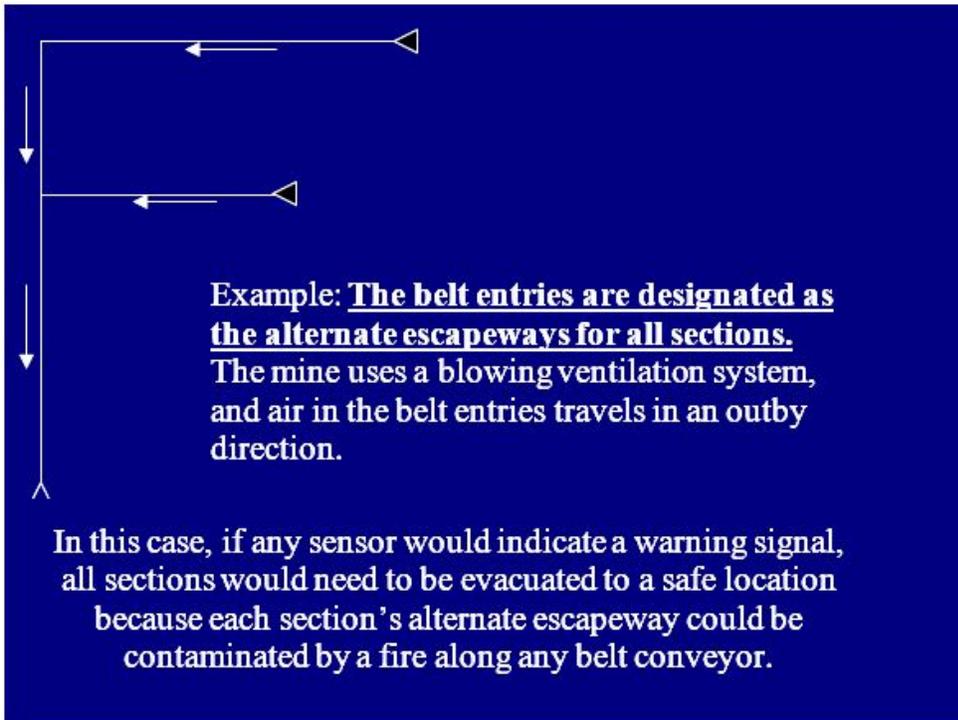


Figure 13 - Example 1 - Areas that could be affected by activated sensor

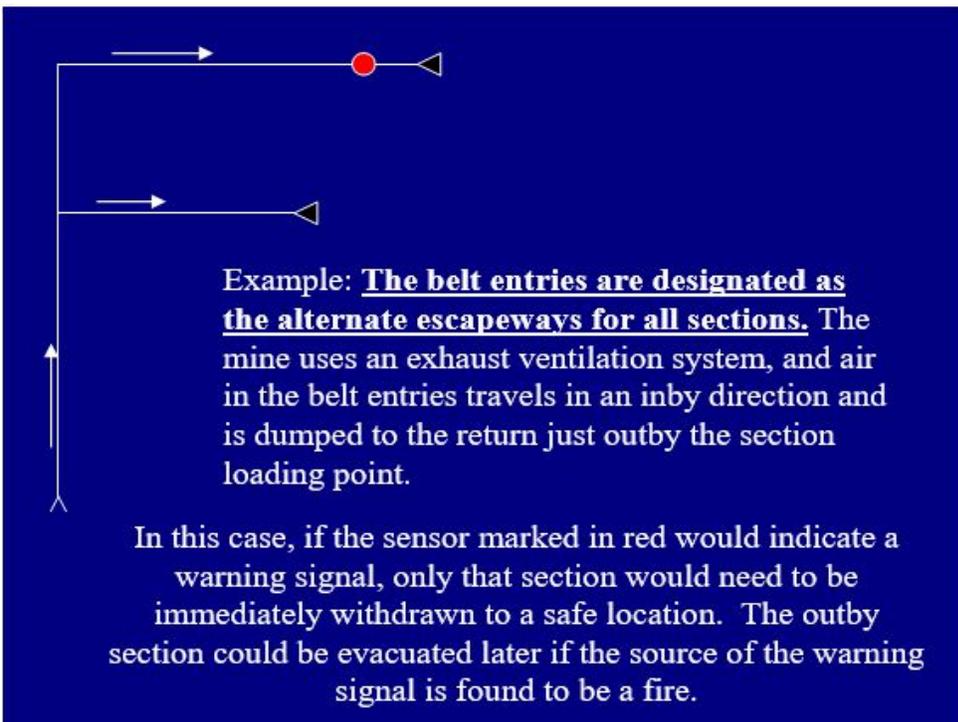


Figure 14 - Example 2 - Areas that could be affected by activated sensor

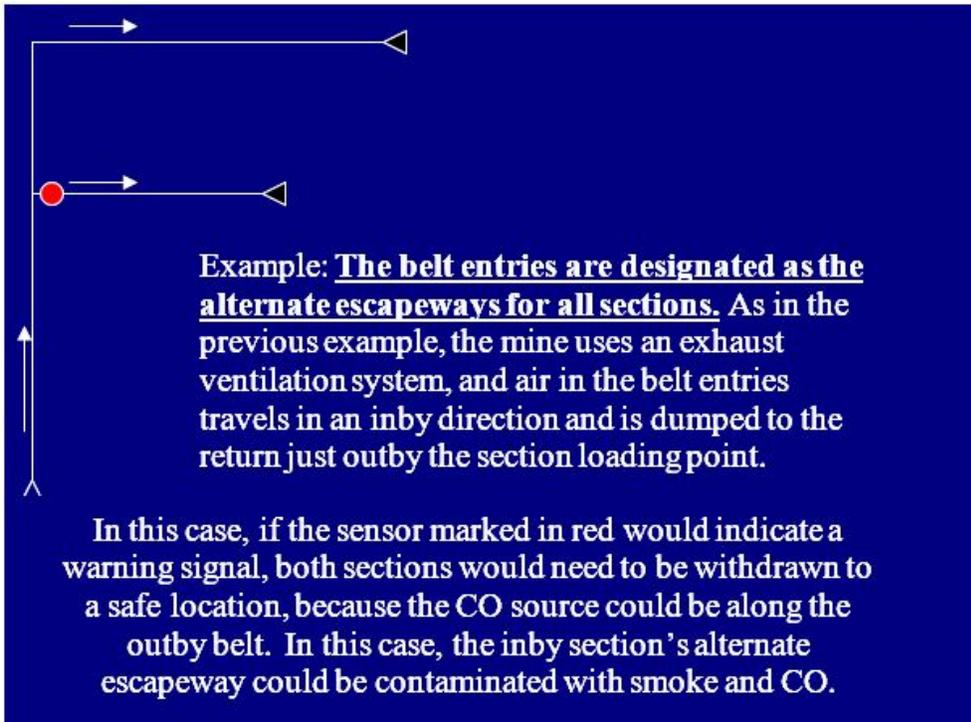


Figure 15 - Example 3 - Areas that could be affected by activated sensor

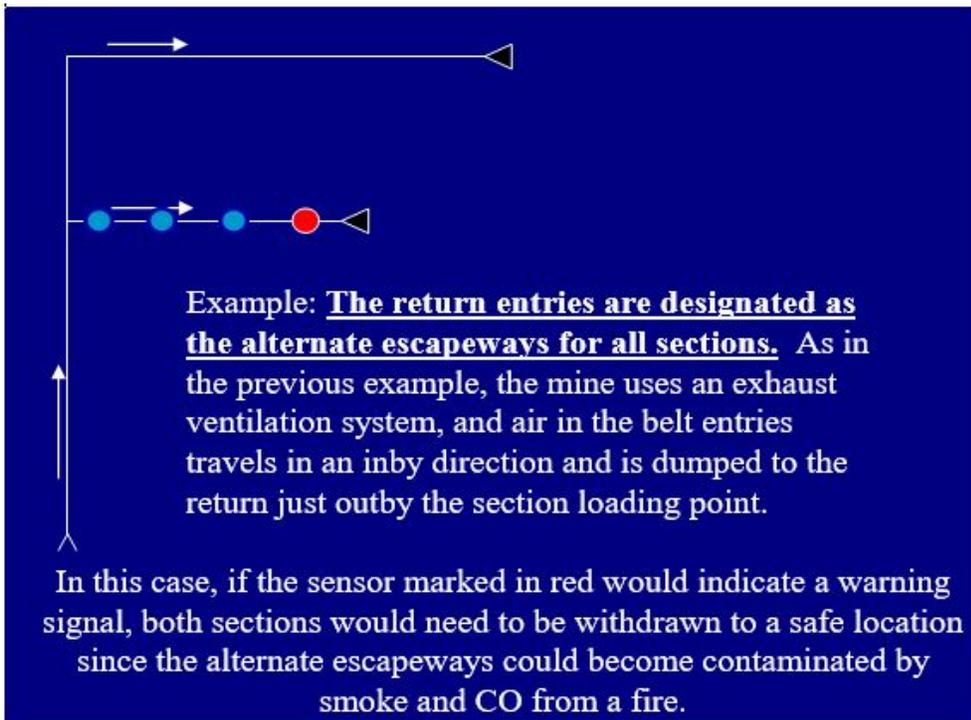


Figure 16 - Example 4 - Areas that could be affected by activated sensor

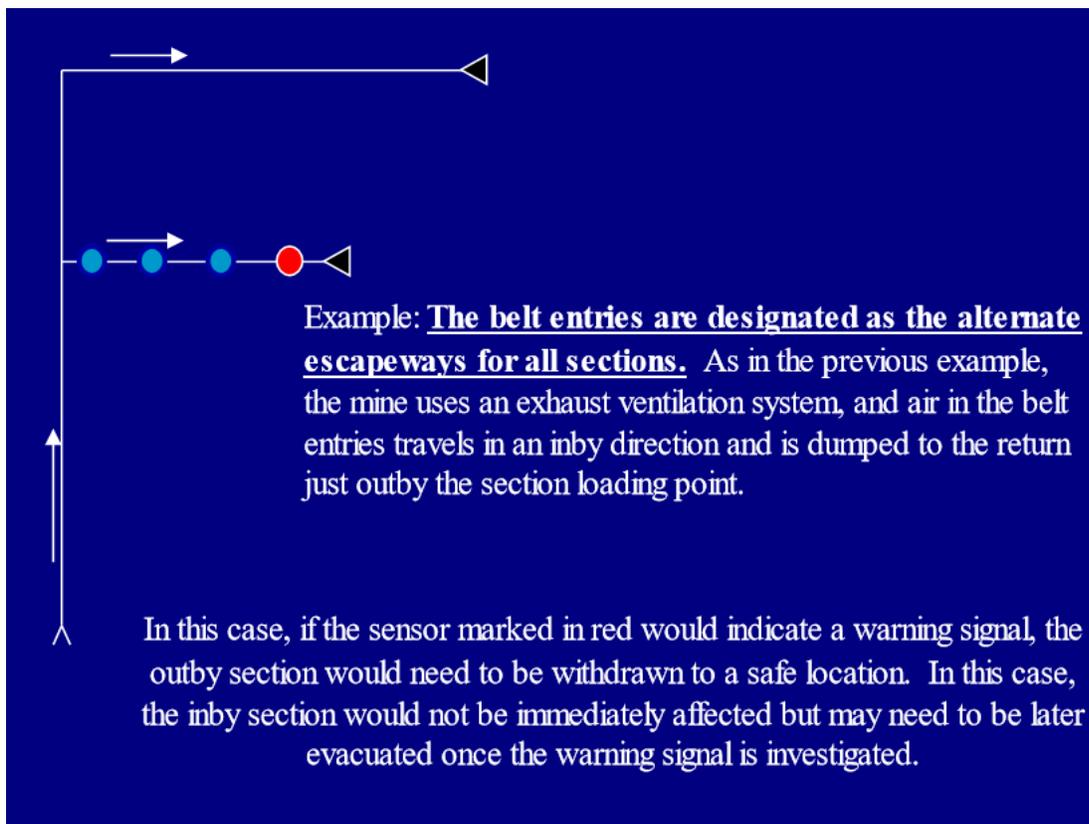


Figure 17 - Example 5 - Areas that could be affected by activated sensor

CHAPTER 5 - RESPONSE TO SYSTEM SIGNALS

The system operator is required to notify the appropriate personnel when an alert, alarm, warning, or malfunction signal is received from an AMS or an automatic fire sensor and warning device system. The appropriate personnel, which may include the system operator, are required to initiate an investigation to determine the cause of the signal and take required actions. When an automatic fire sensor and warning device system indicates a warning, an AMS indicates an alarm, or any two consecutive AMS sensors indicate an alert at the same time, miners in the affected areas must be notified and immediately withdrawn to a designated safe location unless they have been assigned emergency response duties, or appropriate personnel determine the signal does not present a hazard to miners.

Notification of appropriate personnel by the system operator depends upon the type of signal received. For example, if a malfunction signal is received, it may be most appropriate to contact the person responsible for installing and maintaining the system or an electrician trained to work on the system. For an alert signal, the appropriate person may be the belt attendant. For an alarm signal, the appropriate person may be the section foreman for any of the areas affected.

If an inspector is at a mine when the monitoring system activates an alert, alarm, warning, or a malfunction signal, the inspector should determine whether the response is in accordance with the applicable standards, Ventilation Plan, Evacuation Plan, or PFM as applicable. Inspectors must not initiate alarms to determine whether the response is appropriate.

A. In response to alert and alarm signals, the following are required at a mine using air from a belt entry to ventilate a working section:

1. If any CO sensor indicates an alert, the system operator must promptly alert appropriate personnel who then must promptly initiate an investigation to determine the cause of the signal (e.g. source of the alert). If an alarm signal occurs during this investigation, or if a second sensor indicates an alert condition at the same time, appropriate personnel must notify miners in affected areas who then must be withdrawn to a safe location. If it is determined that a fire exists, all personnel not needed for firefighting activities must be evacuated from the mine.
2. If any CO sensor indicates an alarm level, the system operator must promptly alert appropriate personnel who must notify miners in affected areas, and all personnel in the affected areas, unless assigned other duties under §75.1502, must be withdrawn to a safe location. All personnel shall

remain at that location until the reason for the alarm has been determined and action has been taken to correct the condition. If it is determined that a fire exists, all persons not required for firefighting activities must be evacuated from the mine.

3. During calibration and testing of sensors and alarms the system operator must be notified prior to and upon completion of calibration and testing.

Note: A warning signal from an automatic fire sensor and warning device system should be handled the same way as an alarm for an AMS.

B. In response to a malfunction signal, the following is required:

1. If any fire detection components of the AMS malfunction or are inoperative, the mine operator must take immediate corrective actions to return the system to proper operation (e.g. repair or replace the equipment causing the malfunction)
2. While repairs are being made, the belt conveyor may continue to operate provided the affected portion of the belt conveyor is continuously patrolled and monitored for CO by a trained person(s) provided with a two-way communication device to allow communication with the surface as per §75.1103-5(h):
 - a. Each person monitoring must be provided with a hand-held CO detection device;
 - b. If one sensor becomes inoperative, the person must monitor for CO at that sensor location;
 - c. If two or more adjacent sensors become inoperative, the person(s) must patrol and monitor for CO or smoke so that the affected areas are traveled each hour in their entirety; and
 - d. If the complete system becomes inoperative, a sufficient number of persons must patrol and monitor the affected areas for CO or smoke so that these entries are traveled in their entirety once each hour.

When the air velocity is less than the minimum velocities required the following actions are required:

1. Immediate action must be taken to return the ventilation system to proper operation; and
2. While the ventilation system is being corrected, operation of the belt may continue only while a trained person(s) patrols and continuously monitors for CO or smoke, as stated above, so that the affected areas will be

traveled each hour in their entirety.

Note: The mine operator may elect to program an alert level for an automatic fire sensor and warning device system using carbon monoxide sensors. This can be advantageous to the operator by providing a signal that can be investigated prior to reaching a CO level that requires miner evacuation. This extra precaution is not required by the standard.

CHAPTER 6 - CLASS I-A, II-A, AND V-A METAL AND NONMETAL MINES

A. Surface Inspection.

1. Verify the system is installed and performs as per §57.22301(a) & (b).
2. Verify the system is calibrated as per §57.22301(c).

B. Underground Inspection.

1. Verify the system is installed and performs as per §57.22301(a) & (b).
2. Verify the system is calibrated as per §57.22301(c).

APPENDIX A - OUTSTATIONS

“Outstation” means the circuitry located above ground, or in intake air, which interfaces sensors with the central control area. Blue outstations may monitor sensors located in areas where equipment is required to be permissible. Red outstations are not connected to any circuits entering or located within areas where equipment is required to be permissible.

While many systems use outstations for power and data acquisition, not all systems use outstations. It is recommended, but not required, that an electrical specialist conduct the required inspection of outstations. Labeling requirements only apply if the system includes components located in areas where permissibility is required. If outstations are used, verify the following:

1. All outstations are located in intake air.
2. Outstations are identified as "RED" or "BLUE". If the outstation is not painted, verify that other means of identification are used to identify the outstation as red or blue. See Figures A1 and A2. Both red and blue outstations must be located in intake air.
 - a. Red outstations are used only when sensors are located in intake air. Wiring passing into or through an area where permissible equipment is required may not be connected to a red outstation. Sensors used in an area requiring permissible equipment must not be connected to a red outstation.
 - b. Blue outstations are used when sensors are located in either fresh air or areas where permissible equipment is required. Blue outstations are required to have the following:
 - i. An evaluation label on the outstation,
 - ii. A classification label on each power circuit (PC) barrier, and
 - iii. A classification label on each letter class (LTR) barrier.
3. Verify the following if a blue outstation is connected to a sensor located in an area where permissible equipment is required:
 - a. The system is wired in accordance with the acceptance drawing.
 - b. The PC and LTR barriers are housed in separate compartments or enclosures.
 - c. Intrinsically safe circuits are separated from non-intrinsically safe circuits as required by §18.68(c)(3).
 - d. If LTR barriers are connected in parallel, note the barrier letter class and issue number and contact A&CC at (304) 547-0400 for evaluation.



Figure A2 - Examples of red and blue outstations

- e. The wiring of any non-classified sensors and alarm units connected to a blue outstation do not enter the classified (LTR) barriers compartment of the blue outstation. These non-classified sensors and alarm units that are connected to a blue outstation must not be connected to any electric equipment other than the blue outstation, unless a PC barrier is used, as shown on Figure A3.

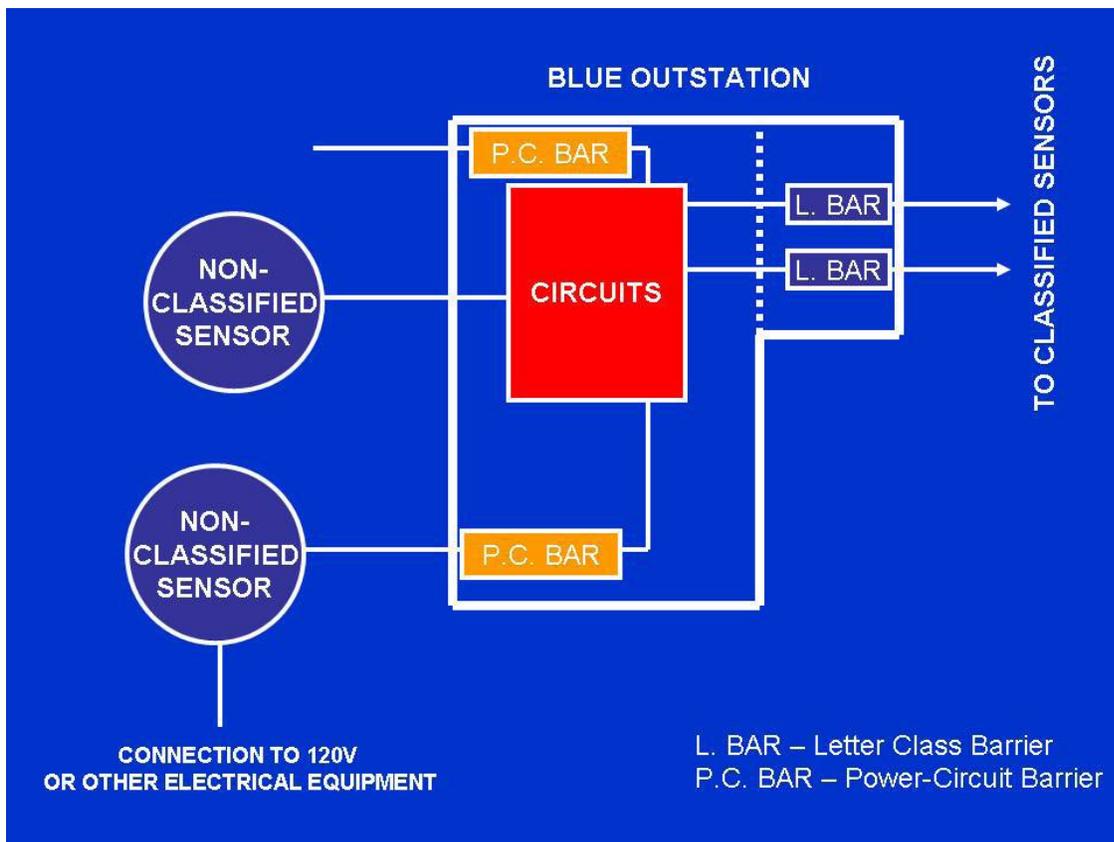


Figure A3 - Connection of non-classified sensors to blue outstation.

- f. All sensors and alarm units connected to barriers have the same classification as the barrier.
- g. Verify the following when a blue outstation is connected to an explosion-proof (X/P) enclosure:
 - i. The evaluation label on the blue outstation indicates that connection to X/P equipment is permitted. See Figure A4.
 - ii. The barrier classification label is located on the exterior of the X/P enclosure and in close proximity to each and every barrier cable entrance. See Figure A5.

- iii. The interconnection of the monitoring system with an X/P enclosure is shown on the equipment approval documentation on file at the A&CC or on an accepted Field Modification.
- iv. Barriers (LTR and PC) installed inside the X/P enclosure correspond with the labels on the outside of the enclosure. See Figure A6.



Beitzel Corporation
Mine Wide Monitoring System
Type 128271
Evaluation No. MMS-22-0

CONDITIONS OF USE:

1. This enclosure must remain in fresh air.
2. The installation/maintenance manual and checklist for this system, identified as Form # DOC-128271-1, must be provided to the user.
3. A signed installation checklist(s) for this blue outstation must be maintained and available at this blue outstation.
4. Sensor classification must agree with the classification of the barrier to which it is connected. Exception: Z class sensors may be connected to any class barrier.
5. All circuits leaving the barrier enclosure and terminated at appropriately classified sensors are intrinsically safe. Therefore, the installation shall preclude intermingling between all circuits leaving the attached barrier enclosure and all other circuits, wires and cables.

Note: System performance not considered for this evaluation.



GIANGARLO SCIENTIFIC
MINE WIDE MONITORING SYSTEM
MODEL 2002
EVALUATION NO. MMS- 2 - 0

WARNING:

1. THIS ENCLOSURE MUST REMAIN IN FRESH AIR.
2. SYSTEM PERFORMANCE NOT CONSIDERED FOR THIS EVALUATION.
3. THE INSTALLATION/MAINTENANCE MANUAL AND CHECKLIST FOR THIS SYSTEM ARE IDENTIFIED AS 2-82-16-A1 AND HAS BEEN PROVIDED TO THE USER.
4. A SIGNED INSTALLATION CHECKLIST(S) FOR THIS BLUE OUTSTATION IS MAINTAINED AND AVAILABLE AT THIS BLUE OUTSTATION.
5. SENSOR CLASSIFICATION MUST AGREE WITH THE CLASSIFICATION OF THE BARRIER TO WHICH IT IS CONNECTED. EXCEPTION: Z CLASS SENSORS MAY BE CONNECTED TO ANY CLASS BARRIER.
6. ALL SENSOR CIRCUITS LEAVING THE ATTACHED BARRIER ENCLOSURE ARE INTRINSICALLY SAFE WHEN CONNECTED TO AN APPROPRIATELY CLASSIFIED SENSOR AND MUST BE TREATED ACCORDINGLY.
7. ENTRANCE INTO MSHA CERTIFIED EXPLOSION-PROOF ENCLOSURES IS NOT PERMITTED.

Figure A4 - Examples of blue outstation labels. Note the restriction on explosion-proof equipment in label on right.

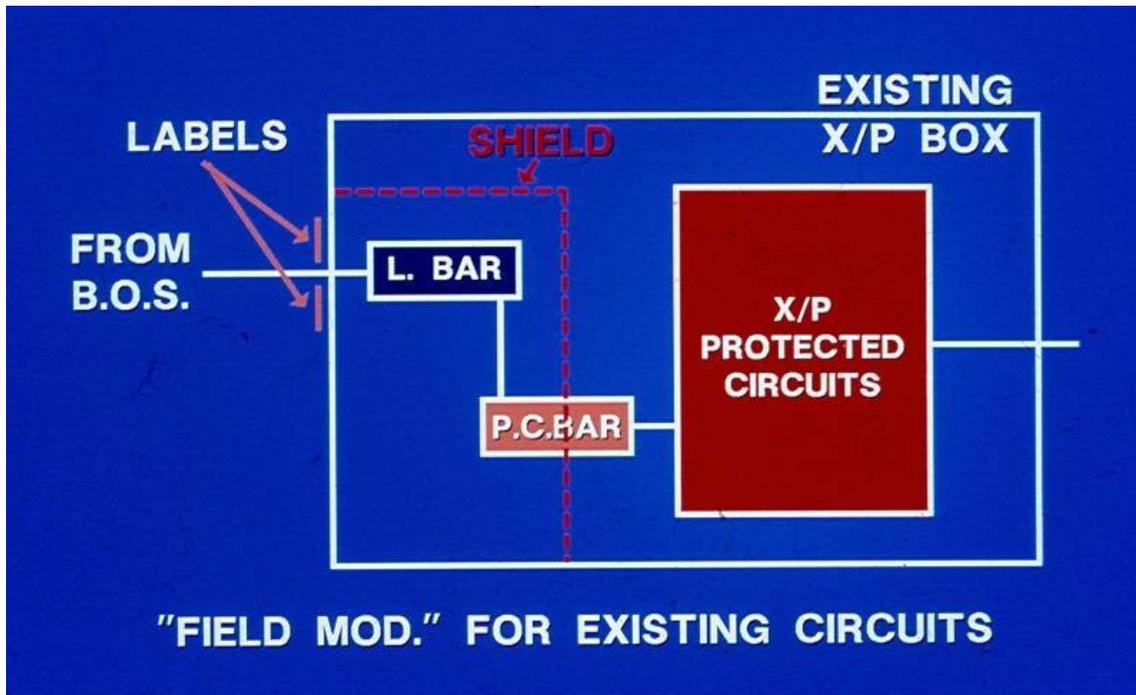


Figure A5 - Example of connection to existing explosion-proof equipment.

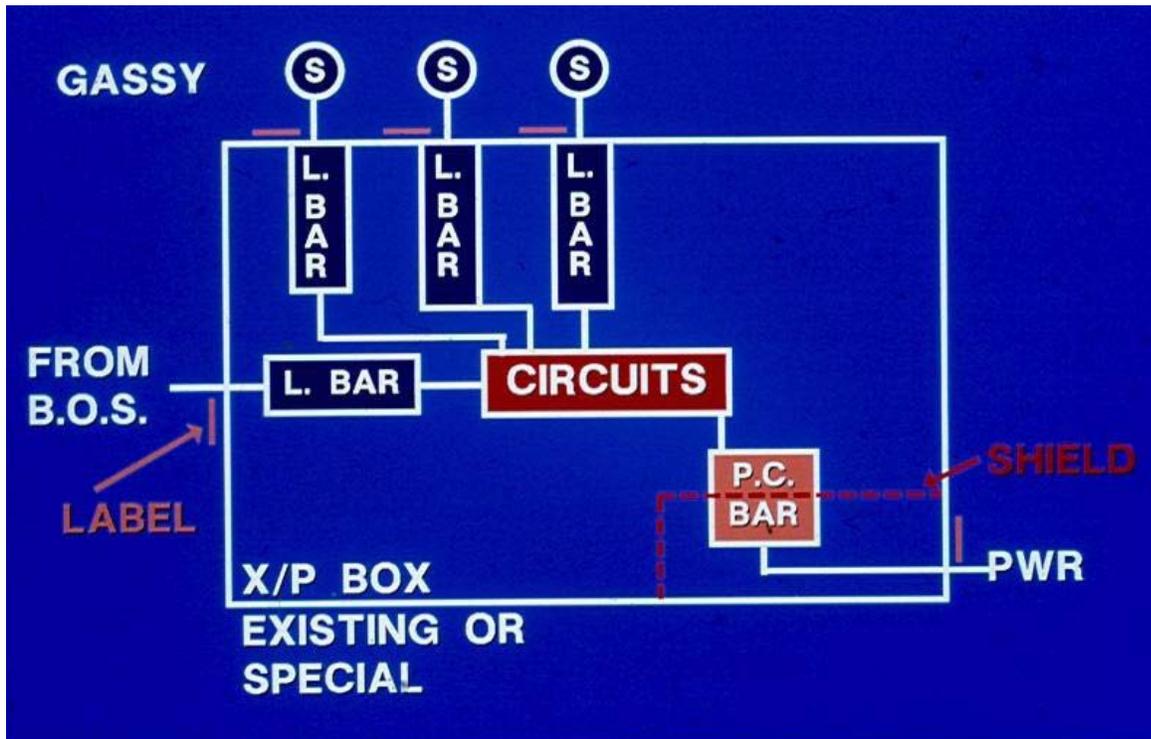


Figure A6 - Connection of blue outstation and sensors to explosion-proof enclosure. Labels shown at the cable entrances should match corresponding barrier.