

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

1.0 PURPOSE

This application procedure specifies the documentation, equipment, and components necessary for the Mine Safety and Health Administration (MSHA) to evaluate an application for evaluation of Mine-Wide Monitoring Systems, barrier classifications, and sensor classifications.

2.0 SCOPE

This Standard Application Procedure (SAP) applies to all applications submitted to the Approval and Certification Center (A&CC) for evaluation of mine-wide monitoring systems, barrier classifications, and sensor classifications.

3.0 REFERENCES

- 3.1. MSHA Program Circular PC-4003-0, "Application Procedures for Evaluation of Mine-Wide Monitoring Systems (MWMS), Barrier Classifications, and Sensor Classifications."
- 3.2. ASAP2006, "Standard Application Procedures – Field Modifications.

4.0 DEFINITIONS

- 4.1. "Classified" means an MSHA acceptance under the Mine-Wide Monitoring System Program that applies to barriers and sensors.
- 4.2. "Data transmission line" means the metallic cable located only above ground or in intake air that interfaces outstations with the central control area.
- 4.3. "Evaluation" means an MSHA acceptance that applies to Mine-Wide Monitoring Systems.
- 4.4. "Letter barrier" means a classified device that limits voltage and current from its protected side and that bears the appropriate MSHA acceptance marking.
- 4.5. "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.

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

- 4.6. "Power circuit (P.C.) barrier" means a classified device that limits the voltage from its protected side and that bears the appropriate MSHA acceptance marking.
- 4.7. "Sensor" means a device providing a sensing or control function and bearing the appropriate MSHA acceptance marking.

5.0 APPLICATION PROCEDURE

- 5.1. General. The Mine Safety and Health Administration's Approval and Certification Center accepts applications for Mine-Wide Monitoring System (MWMS) Evaluations, Barrier Classifications and Sensor Classifications. This document contains application forms and instructions for the evaluation of MWMSs, and for barrier and sensor classification for use on MWMSs. These evaluations or classifications are not applicable for use on other systems, approvals, acceptances or investigations. These application instructions are intended to provide a simple procedure whereby complex systems with specifications within recognized limits for safety can be expeditiously processed. Insufficient information will result in application cancellation. For further information, contact the Chief, Electrical Safety Division, at 304-547-0400.
- 5.2. Application Letter. An application letter for a Mine-Wide Monitoring System Evaluation should contain the following information. Classification requests for barriers and sensors do not require a letter; the appropriate form should be used for those devices. Blank forms are attached to this document.
- 5.2.1. The company name, address, telephone number and the name of the company representative.
- 5.2.2. A company assigned code number - a unique six-digit numerical code assigned by the applicant.
- 5.2.3. The date.
- 5.2.4. The functional block diagram and/or specification(s) of the Mine-Wide Monitoring System including drawing number(s) and revisions. The functional block diagram should contain the necessary interconnection information to insure compliance with the MWMS drawing(s) and specification(s) requirements.

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

5.2.5. The installation and maintenance - inspection manual used by the installer and maintained at the installation site, to insure that each MWMS is installed and maintained according to the conditions stipulated in the application. As a minimum, the installation and maintenance inspection manual must contain the following information:

- Form Number/Date.
- Characteristics to be inspected and/or tested, with limits.
- Method of testing or inspection.
- Results of testing or inspection.
- Signature and date.

5.2.6. Signature of the company representative.

5.3. Drawing And Specification Requirements. Drawing(s) and specifications submitted for a Mine-Wide Monitoring System should show that:

5.3.1. All interfaces to any data transmission line contain circuitry limiting the Data Transmission Line voltage to a maximum of 60 volts per conductor to ground.

5.3.2. All outstations are either blue or red in color and are located in intake air.

5.3.2.1. Blue outstations may monitor sensors located in areas where equipment is required to be permissible.

5.3.2.2. Red outstations are not connected to any circuits entering or located within areas where equipment is required to be permissible.

5.3.3. All outputs of these power circuit (P.C.) barriers (which are inputs to blue outstations) are 120 volts or less. Guidance for voltage classification of power circuit (P.C.) barriers can be found in the Appendix. Power circuit (P.C.) barriers are required to be shown at the following locations:

5.3.3.1. Where the data transmission line connects to all blue outstations. In this case, the barrier voltage classification of the power circuit (P.C.) barrier must be greater than, or equal to, the highest power circuit voltage being monitored.

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

- 5.3.3.2. In inputs to all blue outstation from power circuits or sensors requiring external power for operation. In these cases, the voltage classification of the power circuit (P.C.) barrier must be greater than, or equal to, the maximum voltage of the circuit monitored, or supplied to the barrier, or being supplied to the sensor for operation.
- 5.3.4. All sensors in areas where equipment is required to be permissible have an MSHA classification label. (The classification label shall designate an alphabetical classification for the sensor and the label shall be attached to the sensor or, when necessary for inspection purposes, near the sensor. i.e., an oil level sensor label could be on the oil tank at the point of cable entry.)
- 5.3.5. Cables from MSHA classified sensors terminate in an MSHA classified barrier of the same classification. MSHA classified barriers are located at a blue outstation.
- 5.3.6. Cables from MSHA classified barriers that terminate in explosion-proof enclosures located in areas where equipment is required to be permissible, comply with the following conditions:
 - 5.3.6.1. The modification of existing permissible electrical equipment and circuitry within the permissible electrical equipment shall be documented by the operator under an acceptable Field Modification Application.
 - 5.3.6.2. Cable termination (data transmission line from a blue outstation) within MSHA certified enclosures are to a barrier with a classification that matches the classification of the barrier at the blue outstation. A P.C. barrier with a voltage rating greater than or equal to the voltage input to the enclosure is required when power circuits are monitored or power is obtained from within the MSHA certified enclosure.
 - 5.3.6.3. All cables leaving an MSHA certified enclosure and terminating in a sensor must meet the following conditions:
 - 5.3.6.3.1. The sensor has a classification label.
 - 5.3.6.3.2. The cable is shielded and the shield grounded at the MSHA certified enclosure.

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

- 5.3.6.3.3. The sensor classification has the same letter classification as a barrier located within the MSHA certified enclosure and connected to each individual sensor cable. A barrier classification label shall be located on the exterior of the MSHA certified enclosure and near each barrier cable entrance.
- 5.3.6.3.4. Connections to the data transmission line shall be between the data transmission line classified barrier and the P.C. barrier when a P.C. barrier is required.
- 5.3.6.4. Physical isolation is provided within an MSHA certified enclosure by means of an insulated or grounded metallic shield around all barriers and cables.
- 5.3.7. All sensors whose cable passes through an area where permissible equipment is required have an MSHA classification label and interface with a blue outstation through an MSHA classified barrier of the same classification.
- 5.3.8. Barriers or barrier enclosures are attached to the blue outstation and are so labeled that barrier outputs identify the type of sensor to which the barrier cable is connected, i.e., CO Sensor, CH₄ Sensor, Anemometer.
- 5.3.9. All cables entering blue outstations from the P.C. barriers; connecting a classified barrier with a classified sensor; and connecting the blue outstation with non-classified sensors are shielded with the shield connected to earth ground at the outstation.
- 5.3.10. Grounding techniques for outstations and barriers are employed using no less capacity than a No. 12 AWG wire.
- 5.3.11. All blue outstations shall contain an MSHA evaluation label with the conditions of use as specified by MSHA.
- 5.3.12. MWMS components and circuits (except under the conditions in 5.5.13) underground automatically deenergize upon loss of mine ventilation. Manual deenergization from a centralized surface control area is acceptable. Manual reenergization of each individual underground outstation is required.

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

5.3.13. Fire detection circuits that monitor conveyor belts or conveyor belt entries meet the conditions specified by 30 CFR 75.1103, including the capability to monitor for four hours upon loss of mine power. Exception: circuits shall deenergize either manually or automatically upon loss of mine ventilation, unless the power supply and circuits have been accepted by MSHA as intrinsically safe. Such circuits must be manually reenergized at each individual underground outstation.

5.3.14. Detailed installation and maintenance instructions are supplied to all purchasers or users of these systems. Installation inspection checklists must be included.

5.3.15. Restrictions of use and modification of the system are explained to purchasers or users of these systems.

5.4. Application Instructions For Barriers (Power Circuit (P.C.) Voltage Or Alphabetical Classification). Complete the application for barrier evaluation form (MSHA-15) (attached to this procedure) as follows:

5.4.1. Enter the company name and return address in the spaces provided. Include the name of the representative to be contacted if additional information is needed.

5.4.2. Enter the telephone number (including area code) of the company's representative in the space designated "Telephone No."

5.4.3. Enter the date in the space designated "Date."

5.4.4. Enter the company assigned code number in the space designated "Company Assigned Code No." (Unique six-digit numerical code assigned by the applicant.)

5.4.5. Enter the manufacturer's descriptive name for the barrier in the space designated "Nomenclature."

5.4.6. Enter the name of the company that manufactures the barrier in the space designated "Manufacturer."

5.4.7. Enter the manufacturer's assigned part number or model number of the barrier in the space designated "Part/Model No."

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

- 5.4.8. Enter the barrier classification requested (See Table 1 for alphabetical classification or enter the Power Circuit (P.C.) Voltage classification requested) in the space designated "Class Requested."
- 5.4.9. Enter the highest voltage level (nominal plus tolerances) that will be available at the output terminals of the barrier in the space designated "Maximum Output Voltage."
- 5.4.10. Enter the highest current value (nominal plus tolerances) that will be available at the output terminals of the barrier in the space designated "Maximum Output Current."
- 5.4.11. Enter the barrier rated voltage in the space designated "Barrier Input Voltage Rating." Barrier rated voltage shall meet or exceed 250 volts.
- 5.4.12. If applicable, enter the approval agency and the referenced published standard under which the device has been evaluated, in the space designated "Approval Agency." Applications referencing approval agencies should include a copy of the applicable standard, the address of the approval agency, and a copy of the test report.
- 5.4.13. Provide the electrical schematic of the basic barrier design in the space designated and, if appropriate, a reference to the drawing(s) that apply to the barrier design in "Electrical Schematic or Drawing Reference(s)."
- 5.4.14. The statement shall be completed by having an authorized representative sign in the space labeled "Original Signature" and entering the title and company name in the appropriate spaces on the application. The individual signing the application shall be an authorized representative of the applicant, who can bind the applicant to the conditions stipulated in the application letter.
- 5.4.15. The Barrier Classification Application Letter (MSHA-15) shall be submitted for each type barrier being evaluated. Any drawing or specification sheet being submitted as documentation for the barrier classification shall comply with the following:
- 5.4.15.1. All drawings(s) must have a title block, a title, a number assigned, a date, and be legible.
- 5.4.15.2. Pencil or ink notations must not appear on submitted drawings.

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

5.4.15.3. Drawings must show the date of the latest revision.

5.4.15.4. All drawings must include a note "Do Not Change Without Approval of MSHA" which is included on all drawings reproduced by the applicant.

5.4.15.5. All drawings must be in English.

5.4.16. A barrier sample must be submitted with all applications for barrier classification. If requested, the barrier will be returned by MSHA upon completion of the investigation.

TABLE 1

CLASS	VOLTS (Output)	CURRENT (Max)	CAPACITANCE (Max)	INDUCTANCE (Max)
A	5V	3A	5 mF	100 uH
B	5V	1A	5 mF	1 mH
C	10V	3A	60 uF	100 uH
D	10V	1A	60 uF	1 mH
E	12V	3A	30 uF	100 uH
F	12V	1A	30 uF	1 mH
G	15V	1.25A	15 uF	300 uH
H	20V	0.7A	7 uF	1 mH
J	25V	0.3A	3 uF	10 mH
K	30V	0.1A	1 uF	15 mH
L	18V	1.0A	10 uF	1 mH
Z	Sensor may be connected to any class barrier (non-electrically operated switching devices, thermocouples, or resistance temperature detectors).			

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

5.5. Application Instructions For Sensor Classification

- 5.5.1. For those sensors that do not contain either active chemical or hot filaments and have been previously accepted by MSHA, the application for sensor classification should be completed using Form MSHA-16 (attached to this procedure). Complete the form as follows:
 - 5.5.1.1. Enter the company name and return address in the spaces provided. Include the name of the representative to be contacted if additional information is needed.
 - 5.5.1.2. Enter the telephone number (including area code) of the company's representative in the space designated "Telephone Number."
 - 5.5.1.3. Enter the date in the space designated "Date."
 - 5.5.1.4. Enter the assigned company code number in the space designated "Company Assigned Code No." (Unique six-digit numerical code assigned by the applicant.)
 - 5.5.1.5. An authorized representative of the company shall sign in the appropriate space labeled "Original Signature." The individual signing the application shall be an authorized representative of the applicant who can bind the applicant to the conditions stipulated in the application letter.
 - 5.5.1.6. Enter the manufacturer's descriptive name for the sensor in the space designated "Nomenclature."
 - 5.5.1.7. Enter the name of the company that manufactures the sensor in the space designated "Manufacturer."
 - 5.5.1.8. Enter the manufacturer's assigned model number of the sensor in the space designated "Model No."
 - 5.5.1.9. Enter the sensor classification(s) requested in the space designated "Class Requested." Sensor classification(s) should be consistent with the specifications of the barrier classification(s) to which it will be connected. (See Table 1.)

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

- 5.5.1.10. Enter the total of all the capacitance (nominal values plus tolerances) contained in the sensor in the space designated "Maximum Total Capacitance." If the sensor has no capacitance, indicate with "None."
- 5.5.1.11. Enter the total of all the inductance (nominal values plus tolerances) contained in the sensor in the space designated "Maximum Total Inductance." If the sensor has no inductance, indicate with "None."
- 5.5.1.12. Enter the lowest value (nominal value less tolerance) for each resistor power rating used in the sensor circuitry in the space designated as "Minimum Resistor Ohmage." (e.g., 5.3 ohms, 5 watt; 100k ohms, 1/4 watt).
- 5.5.1.13. Enter a brief description of the basic sensor design (i.e., manufacturer's specifications, circuit design, internal components, etc.) in the space designated "Brief Description of Design." If electrical schematic, layout design, or parts lists are necessary, the drawing number(s) shall be listed under the "Brief Description of the Design."
- 5.5.1.14. The application letter shall be completed by having an authorized representative sign in the space provided for original signature and entering the title and company name in the appropriate spaces. The individual signing the application shall be an authorized representative of the applicant who can bind the company to the conditions stipulated in the application letter.
- 5.5.2. For those sensors that are Active Chemical/Hot Filament and have been previously accepted by MSHA, the application for sensor classification should be completed using form MSHA-17 (attached to this procedure). Complete the form as follows:
- 5.5.2.1. Enter the company name and return address in the spaces provided. Include the name of the representative to be contacted if additional information is needed.
- 5.5.2.2. Enter the telephone number (including area code) of the company's representative in the space designated "Telephone No."
- 5.5.2.3. Enter the date in the space designated "Date."

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

- 5.5.2.4. Enter the assigned company code number in the space designated "Company Assigned Code No." (Unique six-digit numerical code assigned by the applicant.)
- 5.5.2.5. An authorized representative of the applicant shall sign in the appropriate space labeled "Original Signature." The individual signing the application shall be an authorized representative of the applicant who can bind the company to the conditions stipulated in the application letter.
- 5.5.2.6. Enter the manufacturer's descriptive name for the sensor in the space designated "Nomenclature."
- 5.5.2.7. Enter the name of the company that manufactures the sensor in the space designated "Manufacturer."
- 5.5.2.8. Enter the manufacturer's assigned model number of the sensor in the space designated "Model No."
- 5.5.2.9. Enter the sensor classifications requested in the space designated "Class Requested." Sensor classifications should be consistent with the specifications of the barrier classifications to which it will be connected. (See Table 1.)
- 5.5.2.10. Enter the total of all the capacitance (nominal values plus tolerances) contained in the sensor in the space designated "Maximum Total Capacitance." If the sensor has no capacitance, indicate with "None."
- 5.5.2.11. Enter the total of all the inductance (nominal values plus tolerances) contained in the sensor in the space designated "Maximum Total Inductance." If the sensor has no inductance, indicate with "None."
- 5.5.2.12. Enter the lowest value (nominal value less tolerance) for each resistor power rating used in the sensor circuitry in the space designated as "Minimum Resistor Ohmage." (e.g., 5.3 ohms, 5 watt; 100k ohms, 1/4 watt)
- 5.5.2.13. Enter the MSHA assigned acceptance number (IA, MM, etc.) where the sensor was previously accepted by MSHA. If the sensor was not previously accepted by MSHA, enter "No" in the space designated "Previously Evaluated."

TITLE: Application Procedures for Evaluation of Mine-Wide Monitoring Systems, Barrier Classifications, and Sensor Classifications

- 5.5.2.14. Enter a brief description of the basic sensor design, including manufacturer's specifications, circuit design, internal components, etc. in the space designated "Brief Description of the Design." If the sensor was previously evaluated, explain any modification to the previously evaluated design.
- 5.5.2.15. The application letter shall be completed by having an authorized representative sign in the space provided for original signature and entering the title and company name in the appropriate spaces. The individual signing the application shall be an authorized representative of the applicant who can bind the company to the conditions stipulated in the application letter.
- 5.5.3. The sensor evaluation application letter (MSHA-16 or MSHA-17) shall be submitted for each type sensor being evaluated. Any drawing being submitted as documentation for the sensor evaluation shall comply with the following:
 - 5.5.3.1. All drawings must have a title block, a title, a number assigned, a date, and must be legible.
 - 5.5.3.2. Pencil or ink notations must not appear on drawings being submitted for documentation.
 - 5.5.3.3. Drawings must show the date of the latest revision.
 - 5.5.3.4. All drawings must include a note "Do Not Change Without Approval of MSHA" which is included on all drawings reproduced by the applicant.
 - 5.5.3.5. All drawings must be in English.
- 5.5.4. A sensor sample must be submitted with all applications for sensor classification. The sensor will be returned by MSHA upon completion of the investigation.

APPLICATION LETTER
Barrier Classification
for use on
Mine-Wide Monitoring Systems

Chief, Approval and Certification Center
Industrial Park Boulevard
RR 1, Box 251
Triadelphia, West Virginia 26059

COMPANY NAME & ADDRESS

Attn: _____

TELEPHONE NO. _____

DATE _____

Company Assigned Code No. _____

GENTLEMEN:

We are requesting an evaluation of a barrier to be used on Mine-Wide
Monitoring Systems.

BARRIER SPECIFICATIONS

1. Nomenclature _____

2. Manufacturer _____

3. Part/Model No. _____

4. Class Requested _____

5. Maximum Output Voltage _____

6. Maximum Output Current _____

7. Barrier Input Voltage Rating _____

8. Approval Agency _____

FOR MSHA USE ONLY

ELECTRICAL SCHEMATIC OR DRAWING REFERENCE(S):

I _____ (Original Signature), _____ (Title)
attest that _____ (Company) will maintain signed inspection records
traceable to each unit on which we affix a classification label, to insure that it meets all the safety requirements listed above.

APPLICATION LETTER
Sensor Classification
for use on
Mine-Wide Monitoring Systems

Chief, Approval and Certification Center
Industrial Park Boulevard
RR 1, Box 251
Triadelphia, West Virginia 26059

COMPANY NAME & ADDRESS

Attn: _____

TELEPHONE NO. _____

DATE _____

Company Assigned Code No. _____

GENTLEMEN:

We are requesting an evaluation of a Sensor Assembly to be used on Mine-Wide Monitoring Systems.

I _____ (Original Signature), attest to the following:

1. No power source is connected to or within the sensor, except through the MSHA Classified Barrier.
2. Chemical or hot filament components do not exist in this sensor.
3. All motors are brushless type.
4. Light-emitting diodes are the only illuminating devices.

SENSOR SPECIFICATIONS

1. Nomenclature _____
2. Manufacturer _____
3. Model No. _____
4. Class Requested _____
5. Maximum Total Capacitance _____
6. Maximum Total Inductance _____
7. Minimum Resistor Ohmage for Each Power Rating _____

FOR MSHA USE ONLY

BRIEF DESCRIPTION OF THE DESIGN: _____

I _____ (Original Signature), _____ (Title)

attest that _____ (Company) will maintain signed inspection records traceable to each unit on which we affix a classification label, to insure that it meets all the safety requirements listed above.

APPLICATION LETTER
Active Chemical/Hot Filament/or MSHA Pre-Accepted Sensor Classification
for use on Mine-Wide Monitoring Systems

Chief, Approval and Certification Center
Industrial Park Boulevard
RR 1, Box 251
Triadelphia, West Virginia 26059

COMPANY NAME & ADDRESS

Attn: _____

Telephone No _____

DATE _____

Company Assigned Code No. _____

GENTLEMEN:

We are requesting an evaluation of a Sensor Assembly to be used on Mine-Wide Monitoring Systems.

I _____ (Original Signature), attest to the following:

1. No power source is connected to or within the sensor, except through the MSHA Classified Barrier.
2. All motors are brushless type.
3. Light-emitting diodes are the only illuminating devices.

SENSOR SPECIFICATIONS

1. Nomenclature _____

2. Manufacturer _____

3. Model No. _____

4. Class Requested _____

5. Maximum Total Capacitance _____

6. Maximum Total Inductance _____

7. Minimum Resistor Ohmage for Each Power Rating_

8. Previously Evaluated _____

FOR MSHA USE ONLY

BRIEF DESCRIPTION OF THE DESIGN: _____

I _____ (Original Signature), _____ (Title)

attest that _____ (Company) will maintain signed inspection records traceable to each unit on which we affix a classification label, to insure that it meets all the safety requirements listed above.

APPENDIX

POWER CIRCUIT BARRIER VOLTAGE RATING GUIDELINES

- A.1. For circuits housed within MSHA certified explosion proof enclosures, the power circuit (P.C.) barrier rating must be “greater than or equal to the (highest) voltage input to (inside) the enclosure.” For example, a set of contacts inside a 950 volt motor enclosure are to be monitored. The P.C. barrier to be used in this application must be at least 950 volts.
- A.2. For circuits located in “fresh air” locations, the P.C. barrier rating must be “greater than or equal to the maximum voltage of the circuit monitored, or supplied to the barrier, or being supplied to the sensor for operation.” The following examples are offered:
 - A.2.1. When 120 VAC is provided to a “blue” outstation for power, a P.C. barrier rated at least 120 volts is required.
 - A.2.2. When a sensor which is located in fresh air and is powered from an external source is connected to a “blue” outstation input, the interfacing P.C. barrier must be rated at least the voltage powering the sensor with a minimum rating being 250 volts. For example, a 250 volt rated P.C. barrier would be necessary for a methane sensor located in fresh air and powered from 120 volt line power.
 - A.2.3. When monitoring a power center located in fresh air, the interfacing P.C. barrier must be rated at least the voltage of the circuit being monitored with a minimum rating being 250 volts. For example, a current transformer on a 950 volt conductor must be interfaced with a P.C. barrier with a rating of at least 950 volts. Likewise, a set of electrically activated contacts must be protected by a P.C. barrier rated at least the voltage level connected to the device. However, if an auxiliary circuit is used to monitor some aspect of a higher voltage power circuit, the voltage rating of the P.C. barrier will be based on the highest voltage of the auxiliary circuit. For example, if the secondary output of a current transformer monitoring a 950 volt circuit is connected to a signal transformer, relay, signal conditioning circuit or a similar device which in turn interfaces a mine monitoring system through a P.C. barrier, the voltage rating of the P.C. barrier will be the highest voltage associated with the auxiliary circuit but not less than 250 volts. The governing rule of thumb is to determine the P.C. voltage rating based on the highest voltage appearing at the device to which the P.C. protected input directly connects.