PIP PCCA001
Fixed Gas Detection Design Criteria
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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PIP PCCA001
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Table of Contents

1. Introduction .............................................. 2
   1.1 Purpose .................................................... 2
   1.2 Scope ..................................................... 2

2. References ............................................... 2
   2.1 Process Industry Practices ............................... 2
   2.2 Industry Codes and Standards ......................... 2

3. Definitions ................................................ 2

4. Requirements ........................................... 3
   4.1 General Design ............................................. 3
   4.2 Types of Combustible Gas Detectors ............... 4
   4.3 Oxygen and Toxic Gas Detectors .................... 5
   4.4 Detector Location ....................................... 5
   4.5 Environmental Considerations ....................... 5
   4.6 Calibration and Testing ............................... 6
   4.7 Detector Electronics .................................... 6

Data Form
PIP PCCA001-D – Fixed Gas Detector Data Sheet
1. **Introduction**

1.1 **Purpose**
This Practice provides design criteria for fixed gas detectors installed in process areas to detect the presence of combustible, oxygen, or toxic gases.

1.2 **Scope**
This Practice addresses combustible, oxygen, and toxic gas detectors permanently installed for ambient air monitoring (e.g., leak detection, oxygen depletion). The technologies included are catalytic bead, infrared, and electrochemical. This Practice does not cover portable gas monitoring equipment, analyzers, or sampling systems.

The systems used to perform data acquisition, alarming, and control action are not covered by this Practice because the solutions are diverse and can include stand-alone to advanced multisystem configurations.

2. **References**

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 **Process Industry Practices (PIP)**
- PIP PCCA001-D - *Fixed Gas Detector Data Sheet*
- PIP PCEA001 - *Fixed Gas Detection Guidelines*

2.2 **Industry Codes and Standards**
- The Instrumentation International Society of Automation (ISA)
  - ANSI/ISA 92.00.01 - Performance Requirements for Toxic Gas Detectors
  - ANSI/ISA 92.00.02 - Installation, Operation, and Maintenance of Toxic Gas Instruments

3. **Definitions**

*detector:* An integral device that consists of a sensor to sense the target gas, electronics to determine the concentration and provide analog, digital, and/or discrete outputs, and may have a local display

*LEL:* Lower explosive limit, which is the minimum concentration of a gas in a gas/air mixture at which the mixture will explode if exposed to an ignition source

*owner:* The party who owns the facility wherein fixed gas detection will be used.

*FM:* Factory Mutual

*UL:* Underwriters Laboratory
4. Requirements

4.1 General Design

4.1.1 Each fixed gas detector shall be permanently installed for ambient air monitoring.

4.1.2 Combustible gases shall be measured using either catalytic bead or infrared (IR).

4.1.3 Oxygen shall be measured using electrochemical detectors.

4.1.4 Toxic gases shall be measured using either electrochemical or IR detectors.

4.1.5 The owner shall specify the following functional requirements (e.g., *PIP PCCA001-D* data sheet):
   a. Detector Types
   b. Gases to be detected
   c. Detector location and elevation
   d. Number of detectors
   e. Alarm limits
   f. Calibration gas mixture

4.1.6 The following detector performance variables shall be considered (e.g., *PIP PCCA001-D* data sheet):
   a. Speed of response
   b. Operating range
   c. Measurement range
   d. Resolution
   e. Interference gases
   f. Multiple gases detection
   g. Sensor poison gases
   h. Sensor life span
   i. Sensor calibration
   j. Sensor saturation
   k. Environmental considerations (e.g., temperature, humidity)
   l. Protection requirements (e.g., rain/dust/sun shields)
   m. Electrical area classification
4.1.7 The manufacturer’s guidelines and requirements shall be followed as a minimum.

4.1.8 Detector shall be approved for the electrical area classification where it will be installed and shall be approved by UL, FM, CSA, or other recognized NRTL.

4.2 Types of Combustible Gas Detectors

4.2.1 General

4.2.1.1 The owner shall specify which type of combustible gas detector to be used.

4.2.1.2 If more than one combustible gas is present at a particular location, the owner shall specify the calibration gas to be used with the following considerations:
   a. Hardest-to-detect (least sensitive) component gas
   b. Lowest LEL component gas
   c. Gas of primary interest

4.2.1.3 Transmitter ranges and meter scales for combustible gas indication shall be 0-100% LEL.

4.2.2 Catalytic Bead Detectors

4.2.2.1 Detectors shall not be mounted in an atmosphere where no oxygen is present.

4.2.2.2 The following substances are known to affect the sensitivity, performance, and life of a detector; therefore the detector shall not be mounted in an atmosphere that has continuous presence of any of these substances without owner’s approval:
   a. Silicones
   b. Free halogens
   c. Halogenated hydrocarbons
   d. Metallic oxides
   e. Sulfur compounds
   f. Halogens
   g. Silicone
   h. Lead containing compounds
   i. Phosphorus containing compounds

4.2.3 Infrared (IR) Detectors

4.2.3.1 The primary combustible gas of interest shall be IR detectable.

4.2.3.2 IR detectors shall not be used when hydrogen is the primary gas of interest.
4.2.3.3 IR detectors shall not be used in environments with expected relative humidity greater than 95%.

4.2.4 Open Path IR Detectors

4.2.4.1 The installation of an open path IR detector shall require owner’s approval.

4.2.4.2 The path length between the enclosures shall not exceed the manufacturer specifications.

4.2.4.3 There shall be no obstructions between the enclosures.

4.2.4.4 Heated optics shall be considered in icing, condensation, and snow conditions (in accordance with manufacturer specifications).

4.2.4.5 The mounting point for both enclosures shall be secure and stable with minimal vibration.

4.2.4.6 Both enclosures shall be mounted in a position where they cannot be knocked out of alignment and guarded from physical damage.

4.3 Oxygen and Toxic Gas Detectors

4.3.1 The owner shall specify the target gas, measuring range, and meter scale for each detector.

4.3.2 Detectors shall be installed, operated, and maintained in strict accordance with their labels, cautions, warnings, instructions, and within limitations stated by the manufacturer.

4.3.3 If an IR detector is used to detect toxic gas, the detector shall meet the manufacturer’s requirements and specifications to ensure that the specified compound and/or gas can be properly detected.

4.4 Detector Location

4.4.1 Each detector shall be installed to detect the presence of the specified gas or gases (i.e., lighter or heavier than air).

4.4.2 Detectors shall be protected from direct sprays of oils and other liquids.

4.4.3 Prevailing wind direction and dispersion shall be considered when detector location is selected.

4.4.4 If gas detection is required at the inlet of air ducts, pressure and airflow across the sensor shall be within manufacturer recommendations.

4.4.5 Infrastructure shall be considered to provide access to detectors for calibration, repair or replacement.

4.5 Environmental Considerations

4.5.1 Each detector shall be suitable for the environment where it will be installed.

4.5.2 Temperature and humidity conditions shall be considered to prevent adverse effect to the gas measurement or damage to the detector.
4.5.3 Guards shall be considered for detectors to protect from mechanical damage, rain, water wash, snow, strong wind, dust, and sand if required by site conditions.

4.5.4 Sunshields shall be considered for detectors mounted in direct sunlight to avoid overheating of the electronics and/or adverse effects to the gas measurement.

4.5.5 Detectors shall be mounted in a manner that minimizes vibration.

4.5.6 Detectors shall not be mounted in close proximity of strong electromagnetic fields RFI/EMI (e.g., power transformers).

### 4.6 Calibration and Testing

4.6.1 Detectors shall be calibrated for the specified gas being monitored.

4.6.2 The owner shall state the frequency of the calibration.

4.6.3 The owner shall determine the calibration gas for each detector.

4.6.4 Defeats, inhibits, or bypasses shall be considered to allow calibration, testing, or maintenance of detectors during normal operation.

4.6.5 System components shall be verified to ensure each detector performs the intended action (e.g., alarm(s), visual display, audible alarms, indicator lights, equipment shutdown, sprinkler trips, etc.).

4.6.6 Infrastructure shall be considered to provide access to detectors for calibration, repair or replacement.

### 4.7 Detector Electronics

#### 4.7.1 General

4.7.1.1 Each detector shall have at least one of the following outputs:

   a. Analog – 4-20 mA
   b. Digital communication
   c. Discrete – relay with dry contacts

4.7.1.2 The logic shall be designed to be fail-safe.

4.7.1.3 Normally open (shelf state) contacts shall be closed during normal operation and shall open on alarm.

4.7.1.4 Detector electronics shall be field configurable.

4.7.1.5 A local display on the detector shall be considered to provide the following information:

   a. Gas concentration
   b. Alarm state
   c. Failure state
**DETECTOR INFORMATION**

### 1.0 DETECTOR SPECIFICATIONS

#### 1.1 FUNCTIONAL REQUIREMENTS

1.1.1 DETECTOR TYPE
- CATALYTIC BEAD
- IR (INFRARED)
- ELECTROCHEMICAL

1.1.2 GASES TO BE DETECTED
- COMBUSTIBLE
- OXYGEN
- TOXIC

1.1.3 NUMBER OF DETECTORS

1.1.4 LOCATION AND ELEVATION

1.1.5 ALARM SETTINGS
- HIGH-HIGH ALARM
- HIGH ALARM
- LOW ALARM
- LOW-LOW ALARM

1.1.6 CALIBRATION GAS MIXTURE

#### 1.2 DETECTOR PERFORMANCE VARIABLES

1.2.1 SPEED OF RESPONSE

1.2.2 OPERATING RANGE

1.2.3 MEASUREMENT RANGE

1.2.4 RESOLUTION

1.2.5 INTERFERENCE GASES

1.2.6 MULTIPLE GAS DETECTION

1.2.7 SENSOR POISON GASES

1.2.8 SENSOR LIFE SPAN

1.2.9 SENSOR CALIBRATION

1.2.10 SENSOR SATURATION

1.2.11 ENVIRONMENTAL CONSIDERATIONS
- TEMPERATURE
- HUMIDITY
- OTHER

1.2.12 PROTECTION REQUIREMENT (RAIN/DUST/SUN SHIELD)

1.2.13 ELECTRICAL AREA CLASSIFICATION
## 1.3 DETECTOR ELECTRONICS

### 1.3.1 OUTPUTS

- ANALOG (4-20 Ma)
- DIGITAL COMMUNICATION (E.G., HART, FIELDBUS, WIRELESS)
- DISCRETE (E.G., RELAY, TRIAC)

### 1.3.2 FAIL SAFE LOGIC DESIGN

### 1.3.3 NORMALLY OPEN CONTACTS (SHELF STATE)

### 1.3.4 FIELD CONFIGURABLE

### 1.3.5 LOCAL INDICATION

- GAS CONCENTRATION
- ALARM STATE
- FAILURE STATE
- OTHER

## 2.0 DETECTOR LOCATION

### 2.1 FIELD LOCATION OF DETECTOR (ATTACH – DESCRIPTION, DRW, etc.)

### 2.2 ELEVATION OF DETECTOR (ABOVE LOCAL GRADE)

### 2.3 OTHER

## 3.0 TEST REQUIREMENTS

### 3.1 MFG. TEST - PERFORMANCE DEMONSTRATION

### 3.2 SAT - SITE ACCEPTANCE TEST - PERFORMANCE DEMONSTRATION

### 3.3 OTHER TEST DOCUMENTS

### 3.4 OTHER

## 4.0 MISCELLANEOUS

### 4.1 SPECIAL INSTRUCTIONS

### 4.2 DIAGRAMS

### 4.3 REFERENCE TO APPLICABLE DOCUMENTS

### 4.4 OTHER