PIP PCEA001
Fixed Gas Detection Guidelines
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.

This Practice is subject to revision at any time.

© Process Industry Practices (PIP), Construction Industry Institute, The University of Texas at Austin, 3925 West Braker Lane (R4500), Austin, Texas 78759. PIP Member Companies and Subscribers may copy this Practice for their internal use. Changes or modifications of any kind are not permitted within any PIP Practice without the express written authorization of PIP. Authorized Users may attach addenda or overlays to clearly indicate modifications or exceptions to specific sections of PIP Practices. Authorized Users may provide their clients, suppliers and contractors with copies of the Practice solely for Authorized Users’ purposes. These purposes include but are not limited to the procurement process (e.g., as attachments to requests for quotation/ purchase orders or requests for proposals/contracts) and preparation and issue of design engineering deliverables for use on a specific project by Authorized User’s client. PIP’s copyright notices must be clearly indicated and unequivocally incorporated in documents where an Authorized User desires to provide any third party with copies of the Practice.

PUBLISHING HISTORY

November 2015  Issued

Not printed with State fund
# PIP PCEA001
## Fixed Gas Detection Guidelines

## Table of Contents

1. **Scope** ........................................................................................................ 2

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

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

4. **General** ......................................................................................................... 2

5. **Combustible Gas Detectors** ........................................................................ 4
   5.1 General ......................................................................................................... 4
   5.2 Catalytic Bead Detectors ............................................................................. 4
   5.3 Infrared (IR) Detectors ................................................................................. 5

6. **Toxic Gas and Oxygen Detectors** ............................................................. 6

7. **Detector Location** ....................................................................................... 6

8. **Environmental Considerations** ............................................................... 6

9. **Calibration and Testing** .............................................................................. 7

10. **Detector Electronics** .................................................................................. 7
1. **Scope**

This Practice provides guidelines for the selection, design, and application of fixed gas monitoring detectors installed in process areas to detect the presence of combustible, oxygen, or toxic gases.

This Practice addresses 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 – *Fixed Gas Detection Design Criteria*
- PIP PCCA001- D – *Fixed Gas Detector Data Sheet*

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

- **lower explosive limit (LEL):** Minimum concentration of a gas in a gas/air mixture at which the mixture can explode if exposed to an ignition source

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

4. **General**

4.1 Fixed gas detection is an integral part of environmental protection and safety programs in the process industries. The following categories of gases are covered in this Practice:

a. Combustible gases – risk to personnel and facilities caused by fire or explosion

b. Oxygen – depletion of personnel oxygen supply (i.e., asphyxiation)
c. Toxic gases – immediate or long term health risks to personnel

4.2 Combustible, oxygen, and toxic gas detectors are permanently installed for ambient air monitoring (e.g., leak detection).

4.3 Combustible gases are measured using either catalytic bead or infrared (IR) detectors.

4.4 Oxygen is measured using electrochemical detectors.

4.5 Toxic gases are typically measured using electrochemical detectors.

4.6 Some toxic gases can be measured with IR or semiconductor detectors. See manufacturer specifications and requirements.

4.7 The owner should provide the following functional requirements (see PIP PCCA001-D data sheet):
   a. Detector types
   b. Gases to be detected
   c. Number of detectors
   d. Detector location and elevation
   e. Alarm settings
   f. Calibration gas mixture

4.8 The following detector performance variables should be considered:
   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

4.9 The manufacturer’s guidelines and requirements should be followed as a minimum for all detectors.

4.10 Detectors should be approved for the electrical area classification at the installation location.

4.11 See ISA 92.00.01 and ISA 92.00.02 for additional information.
5. **Combustible Gas Detectors**

5.1 **General**

5.1.1 There are two combustible gas detector types:
- Catalytic bead
- Infrared

5.1.2 If more than one combustible gas is present at a particular location, the owner should specify the calibration gas to be used in accordance with the following considerations:
- Hardest-to-detect (i.e., least sensitive) component gas
- Lowest LEL component gas
- Gas of primary interest

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

5.1.4 Detectors may require automatic temperature compensation for ambient temperature and humidity changes.

5.2 **Catalytic Bead Detectors**

5.2.1 Catalytic bead detectors require oxygen to operate properly and should not be used in an atmosphere where no oxygen is present.

5.2.2 Extended exposure of the detector to high concentrations of combustible gases can result in degraded sensor performance.

5.2.3 Solvents, chemicals, and polishes containing silicon compounds should not be used to clean a detector because they can damage the sensor.

5.2.4 A sensor can be poisoned and its operation seriously affected by exposure to any of the following substances present in the ambient air being monitored:
- Silicones
- Free halogens
- Halogenated hydrocarbons
- Metallic oxides

5.2.5 The sensitivity of the sensor can be adversely affected by exposure to any of the following substances present in the ambient air being monitored:
- Sulfur compounds
- Halogens
- Silicone
- Lead containing compounds
- Phosphorus containing compounds
5.2.6 If a sensor is to be exposed to any of the gases listed in Sections 5.2.4 and 5.2.5, increased frequency of calibration checks and testing should be considered to ensure the performance of the sensor.

5.2.7 Because exposure to easily oxidized fuels (e.g., hydrogen) can reduce the life of a sensor, alternate sensor types should be considered.

5.3 **Infrared (IR) Detectors**

5.3.1 IR detectors do not require oxygen to operate and can be used in atmospheres that do not have oxygen present.

5.3.2 IR detectors do not detect all combustible gases (e.g., hydrogen) and are limited to detection of hydrocarbons.

5.3.3 IR detectors measure different hydrocarbons at specific wavelengths and can be tuned to detect specific gases. See manufacturer’s allowable gases.

5.3.4 Moisture is an IR blocker and IR detectors should not be used in environments with expected relative humidity greater than 95%.

5.3.5 IR detectors can be used in locations with exposure to constant background gases because of the following:
   a. Sensor is not susceptible to damage or poisoning by certain gases.
   b. Sensor does not respond to hydrogen.
   c. Some sensors can be tuned to detect certain specific gases.

5.3.6 Single point IR detectors have the following features:
   a. Source and sensor are contained within one enclosure.
   b. Measurement is limited to a single point at the detector.

5.3.7 Open path IR detectors have the following features:
   a. Typically, the IR source and detector are in two different enclosures.
   b. Can detect combustible gases between the IR source and detector.

5.3.8 Open path IR detectors should be installed as follows:
   a. The path length between the enclosures should be approximately 200 m (660 ft) or less and in accordance with manufacturer’s recommendations.
   b. The detector should have a direct view of the IR source. High traffic areas where personnel or vehicles could block the sensor should be avoided if possible.
   c. Both enclosures should be mounted in locations where they cannot be knocked out of alignment and are protected from physical damage.
   d. Both enclosures should be mounted in locations having minimal vibration.
   e. Heated optics may be required to improve performance in icing, condensation, and snow conditions.
6. **Toxic Gas and Oxygen Detectors**

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

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

6.3 The life span of an electrochemical sensor can be shortened if exposed to high concentration or constant background of certain gases or compounds.

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

7. **Detector Location**

7.1 A dispersion study should be performed to determine the location and number of detectors needed to detect the specified gas or gases.

7.2 Each detector should be located to detect the presence of the specified gas or gases (i.e., lighter or heavier than air) in the area in which the detector is to be installed.

7.3 A combustible or toxic gas detector should be located adjacent to an identifiable, potential release location of the specified gas (e.g., pump and gas compressor seals, valves, tank vents).

7.4 Oxygen detectors should be considered in an area, enclosure, building, or confined space where the potential of an oxygen deficient atmosphere can occur (e.g., analyzer house).

7.5 Detectors should be protected from direct sprays of oils and other liquids.

7.6 Prevailing wind direction and dispersion should be considered when selecting a location for a detector.

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

8. **Environmental Considerations**

8.1 A detector should be specified to be suitable for the installation location environment.

8.2 Temperature and humidity conditions should be considered when selecting a location for a detector to prevent adverse effect to the gas measurement or damage to the detector.

8.3 Guards should be considered to protect detectors from mechanical damage, rain, water wash, snow, strong wind, dust, and sand if required by site conditions.

8.4 Sunshades should be considered for detectors that will be mounted in direct sunlight to avoid overheating of the electronics and/or adverse effects to the gas measurement.

8.5 Detectors should be mounted in a manner that minimizes vibration.

8.6 Water and condensing humidity can cause adverse effects to the gas measurement.

8.7 Strong electromagnetic fields can cause adverse effects to the gas measurement such as Radio Frequency Interference (RFI) / Electromagnetic Interference (EMI) (e.g., power transformers).
9. **Calibration and Testing**

9.1 Periodic calibration checks should be performed on detectors to assure dependable performance of the sensors.

9.2 The frequency of calibration checks should be in accordance with manufacturer’s recommendations or as specified by the owner.

9.3 The owner should specify the calibration gas for a detector.

9.4 For combustible gas detectors the manufacturer should provide a conversion table or chart that shows equivalent concentrations for other gases as compared to the calibration gas.

9.5 Defeats, inhibits, or bypasses should be considered to permit calibration, testing, or maintenance of detectors without causing shutdown or disruption of processes or equipment.

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

9.7 Infrastructure should be considered to provide access to detectors for calibration, repair or replacement. Periodic replacement should follow OEM recommendations.

10. **Detector Electronics**

10.1 Each detector should have a minimum of one of the following outputs:
   a. Analog – 4-20 mA
   b. Digital communication
   c. Discrete – relay with dry contacts

10.2 The logic should be designed to be fail-safe.

10.3 Normally open (i.e., shelf state) contacts should be closed during normal operation and open on alarm.

10.4 Detector electronics should be field configurable.

10.5 A local display on a detector should be considered to provide the following information:
   a. Gas concentration
   b. Alarm state
   c. Failure state