

Protocol #07

Confined Space Entry

DGS Accident and Illness Prevention Program (AIPP)

A. Policy Statement

The following protocol for confined spaces is official policy for the PA Department of General Services (DGS) and all of its employees. Authority and responsibility for its execution are pursuant to the DGS Secretary's "Safety Program Policy Statement," [PA Management Directive 530.31](#), [PA Code Title 34 Chapter 129](#) and "[Element C](#)" of the DGS Accident and Illness Prevention Program (AIPP).

This policy includes material that applies directly to DGS operations. It is closely based upon the [OSHA permit-required confined spaces standard](#).

B. Application and Purpose

This protocol applies to all spaces designated as confined spaces based on the assessments conducted by management.

The purpose of this protocol is to protect DGS employees from injury as they enter, work in and exit confined spaces. In addition to following the guidelines included here, employees should observe the fundamentals outlined in all the elements and protocols within the DGS AIPP. Refer to Appendix C for a sheet summarizing Confined Space classifications and definitions.

C. Definitions

Acceptable entry conditions - the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into, work within, and exit from the space.

Attendant - an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the permit space program.

Authorized entrant - an employee who is authorized by management to enter a permit space.

Confined space is a space that:

1. Is large enough and so configured that an employee can bodily enter and perform assigned work, and

2. Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, manholes, and pits are spaces that may have limited means of entry) and
3. Is not designed for continuous employee occupancy.

NOTE: In 2. above, “limited or restricted means for entry or exit” means the entry/exit is a physical configuration that requires use of the hands for support to enter or exit the space.

Emergency - any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

Engulfment - the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction or crushing.

Entry - the action by which a person passes through an opening into a permit-required confined space, including ensuing work activities in that space. Breaking the plane of a confined space’s entryway with any part of one’s body constitutes entry.

Entry permit (permit) - the written or printed document that is provided by management to allow and control entry into a permit space and that contains the information specified in section G. of this protocol.

Entry supervisor - the qualified person (the Safety Inspector) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this protocol.

Hazardous atmosphere - an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury or acute illness from one or more of the following causes:

1. Flammable gas, vapor or mist in excess of 10 percent of its lower flammable limit (LFL);
2. Airborne combustible dust at a concentration that meets or exceeds its LFL;
3. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
4. Atmospheric concentration of any substance for which a dose or permissible exposure limit is published in [29 CFR 1910 Subpart G or Subpart Z](#) and which

could result in employee exposure in excess of its dose or permissible exposure limit;

5. Any other atmospheric condition that is immediately dangerous to life or health.

Fire/safety work permit – a permit required for confined space entry that includes management’s written authorization to enter a confined space.

Immediately dangerous to life or health (IDLH) - any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual’s ability to escape unaided from a permit space.

Inerting - the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible. This procedure produces an IDLH oxygen-deficient atmosphere.

Isolation - the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

Management - DGS personnel with supervisory authority over other employees.

Non-permit confined space - a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

Oxygen deficient atmosphere - an atmosphere containing less than 19.5 percent oxygen by volume.

Oxygen enriched atmosphere - an atmosphere containing more than 23.5 percent oxygen by volume.

Permit-required confined space (permit space) - a confined space that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere;
2. Contains a material that has the potential for engulfing an entrant;
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
4. Contains any other recognized serious safety or health hazard.

Permit-required confined space program (permit space program) - the overall program for controlling, and, where appropriate, for protecting employees from permit space hazards and for regulating employee entry into permit spaces.

Permit system - the written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

Prohibited condition - any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

Rescue service - the personnel designated to rescue employees from permit spaces.

Retrieval system - the equipment (including a retrieval line, chest or full-body harness, wristlets if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

Safety inspector - a DGS Fire, Safety, and Environmental Division employee with the job title “Safety Inspector” who serves as the confined space entry supervisor.

Testing - the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

D. General Requirements

Evaluation of the workplace: A Safety Inspector must evaluate the workplace to determine if a confined space is a permit-required confined space (permit space).

If permit spaces are identified, management shall inform exposed employees of their existence by posting danger signs at their entrances or by any other equally effective means of notice. A sign reading “Danger – Permit-required Confined Space, Do Not Enter” or using other similar language will satisfy the sign notice requirement.

It is recommended that non-permit required spaces be identified as such. DGS tries to label non-permit required confined spaces whenever feasible.

If a confined space without signage is identified, DGS employees should notify their supervisor. The supervisor will notify the DGS Fire, Safety and Environmental Division. A Safety Inspector must evaluate the space to determine if it is a permit space and add the appropriate signage.

Prior to confined space entry, a Fire Safety Work permit must be completed. Completed Fire Safety Work permits shall be sent to the Fire Safety, and Environmental Division (FSED) at GS-firesafetyenv@pa.gov. The Fire Safety Work permit is located in Appendix B. If the space is permit required, the Safety Inspector will complete the permit space entry permit.

Contractors: Contractors who must enter permit spaces on DGS owned or controlled property will be provided with information regarding hazard of the space and shall protect their employees in the same manner or better as described in this protocol for DGS employees. Contractors are required to complete the Fire Safety Work permit. Management will in all situations be responsible for executing this protocol for the protection of DGS employees and shall not delegate that responsibility to any contractor.

Written permit space program: If any employee must enter permit spaces as part of their job functions, this protocol will govern the requirements for entry.

Reclassify to permit space: When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, a Safety Inspector shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space. Refer to Appendix D for a sheet summarizing how the protocol governs reclassifying permit spaces.

Reclassify to confined space: A space classified by a Safety Inspector as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

1. If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.
2. If it is necessary to enter the permit-required confined space to eliminate hazards, such entry shall be performed in accordance with this protocol as it applies to permit-required confined spaces. If testing and inspection during that entry demonstrate the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

Note: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards.

3. A Safety Inspector shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, location of the space and signature of the person making the determination. The certification shall be made available to each employee entering the space.

E. Permit Space Program

Safety Inspector (entry supervisor) shall:

1. Implement the measures necessary to prevent unauthorized entry.
2. Identify and evaluate the hazards of permit spaces before employees enter them.
3. Develop and implement the means, procedures and practices necessary for safe permit space entry operations, including but not limited to the following:
 - a. Specify acceptable entry conditions.
 - b. Provide each authorized entrant with the opportunity to observe any monitoring or testing of permit spaces.
 - c. Isolate the permit space.
 - d. Purge, inert, flush or ventilate the permit space as necessary to eliminate or control atmospheric hazards.
 - e. Provide pedestrian, vehicle or other barriers as necessary to protect entrants from external hazards.
 - f. Verify that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.
4. Maintain the following equipment, and ensure training is completed for the proper use of such equipment.:
 - a. Testing and monitoring (bump tests, calibration, etc.)
 - b. Ventilating equipment
 - c. Communications equipment

- d. Personal protective equipment
 - e. Lighting equipment
 - f. Barriers and shields
 - g. Equipment, such as ladders, needed for safe ingress and egress by authorized entrants
 - h. Rescue and emergency equipment
 - i. Any other equipment necessary for safe entry into and rescue from permit spaces.
5. Evaluate permit space conditions as follows when entry operations are conducted:
- a. Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working.
 - b. Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations.
 - c. When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.
 - d. Provide each authorized entrant an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit spaces.
 - e. Reevaluate the permit space in the presence of any authorized entrant who requests that management conduct such reevaluation because they have reason to believe that the previous evaluation of that space may not have been adequate.
 - f. Immediately provide each authorized entrant with the results of any testing conducted.
6. Provide at least one attendant outside the permit space for the duration of entry operations.

7. Designate the persons who are to have active roles (for example, authorized entrants, attendants) in entry operations, identify the duties of each employee, and verify each employee has the training required to effectively perform those functions.
8. Develop and implement procedures for:
 - a. Summoning rescue and emergency services
 - b. Rescuing entrants from permit spaces,
 - c. Providing necessary emergency services to rescued employees,
 - d. Preventing unauthorized personnel from attempting a rescue.
9. Develop and implement a system for the preparation, issuance, use, completion, and cancellation of entry permits as required by this protocol.
10. Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permits space, so that employees of one employer do not endanger the employees of any other employer.
11. Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed.
12. Review entry operations when management or a Safety Inspector has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized.

NOTE: Examples of circumstances requiring the review of the permit space program would include any unauthorized entry into a permit space, detection of a hazard not covered in the permit, detection of a condition prohibited by the permit, an injury or near-miss during entry, changes in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

F. Permit System

Before entry is authorized, a Safety Inspector shall document the completion of measures required by section E. of this protocol by preparing an entry permit.

1. Before entry begins, the entry supervisor/safety inspector identified on the permit shall sign the entry permit to authorize entry.
2. The completed permit shall be made available at the time of entry to all authorized entrants by posting it at the entry portal or by any other equally effective means so that the entrants can confirm that pre-entry preparations have been completed.
3. The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit.
4. The entry supervisor/safety inspector shall terminate entry and cancel the entry permit when: the entry permit condition that is not allowed under arises in or near the permit space.
5. Management shall retain all completed or cancelled entry permits for at least one year to facilitate the review of the permit-required confined space program.

G. Entry Permit

The entry permit (or inspection record form) used by the Safety Inspectors documents compliance with this protocol and authorizes entry into a permit space shall identify:

1. The permit space to be entered.
2. The purpose of the entry.
3. The date and the authorized duration of the entry permit.
4. The authorized entrants within the permit space by name so that the attendant can determine quickly and accurately which authorized entrants are inside at all times.
5. The persons, by name, currently serving as attendants.
6. The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry.
7. The hazards of the permit space to be entered.

8. The measures used to isolate the permit space and to eliminate or control permit space hazards before entry.
9. The acceptable entry conditions.
10. The results of initial and periodic tests performed in accordance with section E.5. of this protocol, accompanied by the names or initials of the testers and the dates and times of each test performed.
11. The rescue and emergency services that can be summoned and the means for summoning those services.
12. The communication procedures used by authorized entrants and attendants to maintain contact during entry.
13. Equipment to be provided for entrants and attendants, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment.
14. Any other information that needs to be included for the specific circumstances of the particular confined space to be entered in order to ensure worker safety.
15. Any additional permits, such as hot work permits, that have been issued to authorize work in the permit space.

H. Training

Management shall ensure training is provided for authorized employees (entrant, attendant and entry supervisor/safety inspector). At a minimum, training will include:

- Hazard recognition and control procedures
- Communication procedures and equipment
- Personal protective equipment
- Atmospheric testing equipment and procedures
- Entry procedures and safe work practices
- Evacuation/emergency procedures
- Non-entry retrieval equipment and procedures (attendant and entry supervisor/safety inspector only)

Training shall be provided :

1. Before the employee is first assigned duties governed by this protocol
2. Before there is a change in assigned duties
3. Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained
4. Whenever management or a Safety Inspector has reason to believe either that there are deviations from the permit space entry procedures required by this protocol or that there are inadequacies in the employee's knowledge or use of these procedures.

The training shall establish employee proficiency in the duties required by this protocol and shall introduce new or revised procedures, as necessary, for compliance.

Management shall certify that the training required by this protocol has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees.

I. Duties of Authorized Entrants

Management or Safety Inspectors shall ensure all authorized entrants:

1. Know the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of exposure.
2. Properly use equipment as required by this protocol.
3. Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required in this protocol.
4. Alert the attendant whenever:
 - a. The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or
 - b. The entrant detects a prohibited condition.
5. Exit from the space as quickly as possible whenever:

- a. An order to evacuate is given to the attendant or the entry supervisor/safety inspector.
- b. The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.
- c. The entrant detects a prohibited condition.
- d. An evacuation alarm is activated.

J. Duties of Attendants

Management or Safety Inspectors shall ensure each attendant:

1. Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of exposure.
2. Is aware of possible behavioral effects of hazard exposure in authorized entrants.
3. Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under this protocol accurately identifies who is in the permit space.
4. Remains outside the permit space during entry operations until relieved by another attendant.
5. Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space.
6. Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions:
 - a. Detects a prohibited condition.
 - b. Detects the behavioral effects of hazard exposure in an authorized entrant.
 - c. Detects a situation outside the space that could endanger the authorized entrants.

- d. If the attendant cannot effectively and safely perform all the duties required by this protocol.
7. Summons rescue and other emergency services if authorized entrants may need assistance to escape from permit space hazards.
8. Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:
 - a. Warn the unauthorized persons that they must stay away from the permit space.
 - b. Advise the unauthorized persons that they must exit immediately if they have entered the permit space, and
 - c. Inform the authorized entrants and the entry supervisor/safety inspector if unauthorized persons have entered the permit space.
9. Performs non-entry rescues as specified by DGS's rescue procedure.
10. Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

L. Rescue and Emergency Services

1. Management will: Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified.
2. Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified.
3. Select a rescue team or service from those evaluated that:
 - a. Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified; and
 - b. Is equipped for and proficient in performing the needed rescue services.



4. Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site.
5. Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

If management designates DGS employees to provide permit space rescue and emergency services, they shall take the following measures:

1. Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees.
2. Train affected employees to perform assigned rescue duties. Management must also ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant.
3. Train affected employees in basic first aid and cardiopulmonary resuscitation (CPR). Management shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available.
4. Ensure that affected employees practice making permit space rescues at least once every 12 months by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces.

Non-entry rescue retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment increases the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements:

1. Each authorized entrant shall use a chest or full body harness with a retrieval line attached at the center of the entrant's back near shoulder level, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if management can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

2. The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary.
3. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet deep.

If an injured entrant is exposed to a substance for which a Safety Data Sheet (SDS) or other similar written information is required to be kept at the worksite, that SDS or written information shall be made available to the medical facility treating the exposed entrant.

M. Employee Participation

Management shall consult with affected employees on the development and implementation of all aspects of the permit space program required by this protocol.

Management shall make available to affected employees all information required to be developed by this protocol. This confined space protocol will be reviewed annually by the DGS Safety Coordinator with the review maintained on file for the current fiscal year and previous two.

Appendix B – Fire Safety Work Permit

****24 HOUR NOTICE****

FIRE/SAFETY WORK PERMIT

To access the fire/safety work permit, scan: [click here](#) or scan the below QR code:



Appendix C – Confined Space Classification Summary Sheet

Confined spaces can be dangerous. A detailed “Confined Space Protocol” exists to protect DGS employees who must enter such areas. If confined space entry is part of your job, it is very important that you become familiar with Protocol #07 of DGS’ Accident and Illness Prevention Program.

There are two types of confined spaces:

1. Non-permit-required confined spaces, referred to as “confined spaces” and
2. Permit-required confined spaces, referred to as “permit spaces”

Permit spaces are marked with signs that say:

“DANGER CONFINED SPACE No. ____ Entry Permit Required – Call 717-772-4545”

Non-permit-required confined spaces need not be marked with signs.

If you believe that an unidentified confined space exists, please contact your supervisor or Safety Coordinator immediately. It is urgent that all confined spaces be identified, classified, and marked with signs if they are permit spaces.

Confined spaces :

Confined Space – three characteristics must all be present:

1. Are large enough and so configured that an employee can bodily enter and perform assigned work, and
2. Have limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, manholes, and pits are spaces that may have limited means of entry), and
3. Are not designed for continuous employee occupancy.

NOTE: “Restricted entry and exit” means the entry/exit is a physical configuration that requires use of the hands for support to enter or exit the space.

Permit-required confined space (permit space) – a confined space that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere, or
2. Contains a material that has the potential for engulfing an entrant, or
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section, or
4. Contains any other recognized serious safety or health hazard.

Appendix D – Reclassifying from Permit Space to Confined Space

There are two general scenarios in which a Permit Space may be re-classified to a Confined Space. This is a summary of how DGS AIPP Protocol #07 governs these situations.

The two scenarios when re-classification is possible:

1. The only hazard posed by a permit space is an actual or potential hazardous atmosphere.
2. The permit space poses no actual or potential atmospheric hazards and all other hazards within the space are eliminated without entry into the space.

Procedure for Scenario 1:

- a. If continuous forced air ventilation alone is sufficient to maintain a permit space safe for entry, management will develop and keep data that supports that position.
- b. All of the requirements pertaining to this scenario contained in P-07 will be followed. These include pre-entry atmospheric tests as specified.
- c. If entry into the space is necessary in order to conduct the atmospheric tests needed, that entry will be handled as a permit space entry until the atmosphere is certified safe.
- d. Breaking the plane of the entryway into a confined space with any part of one's body constitutes entry for the purposes of P-07 procedures.

If all four of these items, a through d, are in order, then the space may be reclassified to confined space from permit space for as long as monitoring indicates that the space remains safe for entrants.

Procedure for Scenario 2:

- a. All hazards have been eliminated without entering the space.
- b. If entry into the space is required to eliminate its hazards, that entry will be handled as a permit space entry until hazard elimination is complete and the space is certified safe.
- c. Management shall document the basis for determining that all hazards in a permit space have been eliminated through a certification that contains the date, location of the space, and the signature of the person making the determination of safety. This certification shall be made available to each employee entering the space.

If all three of these items, a through c, are in order, then the space may be reclassified to confined space from permit space for as long as the hazards remain eliminated.

Note 1 – Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. It is a risk reduction technique.

Note 2 – If hazards of any sort arise during an entry, occupants shall immediately exit.

Appendix E – Sewer System Entry

Sewer entry differs in three vital respects from other permit entries:

1. It is rarely possible to isolate the space to be entered.
2. Because isolation is not complete, the atmosphere may suddenly become lethally hazardous from causes beyond the control of the entrant or employer.
3. Experienced sewer workers are especially knowledgeable in entry and work in their permit spaces because of the frequency of their entries.

Adherence to procedure: Management should designate entrants who are thoroughly trained in the applicable sewer entry procedures and who demonstrate they follow these entry procedures exactly as prescribed when performing sewer entries.

Atmospheric monitoring: Entrants should be trained in the use of, and be equipped with, atmospheric monitoring equipment which sounds an audible alarm, in addition to its visual readout, whenever one of the following conditions are encountered or deemed possible:

1. Oxygen concentration less than 19.5%.
2. Flammable gas or vapor at 10% or more of the lower flammable limit (LFL).
4. Hydrogen sulfide at or above 50 parts per million/ppm (ceiling limit – evacuate space if without appropriate PPE), or 10 ppm measured as an 8-hour time-weighted average, or 15 ppm (30-minute short term exposure limit/STEL).
5. Carbon monoxide at or above 200 ppm (evacuate if without appropriate PPE National Institute of Occupational Safety and Health/NIOSH 15-minute STEL), or 50 ppm measured as an 8-hour time-weighted average.

Atmospheric monitoring equipment needs to be bump tested and calibrated according to the manufacturer's instructions.

If actual or potential contaminants are NOT YET identified: The oxygen sensor/broad range sensor is best suited for initial use in situations where the actual or potential contaminants have not been identified, because broad range sensors, unlike substance-specific sensors, enable management to obtain an overall reading of the hydrocarbons (flammables) present in the space. However, such sensors only indicate that a hazardous threshold of a class of chemicals has been exceeded. They do not measure the levels of contamination of specific substances.