CONFINED SPACE ENTRY

1.0 INTRODUCTION

During the course of field activities, EPA personnel may be exposed to the hazards associated with confined space operations. It is imperative that field personnel recognize the potential hazards they may encounter and understand the established procedures in order to promote safe, efficient, and productive performance of confined space activities.

This module covers the activities related to confined space entry.

Learning Objectives
At the end of this module, you will be able to:

- Recognize the multiple hazards associated with confined space work
- Understand the respective roles and responsibilities of authorized entrants, attendants, entry supervisors, and rescue personnel
- Recognize a confined space, and assess and control the hazards associated with confined space entry work
- Select, calibrate, use, and maintain specialized equipment and instrumentation necessary to characterize and work within confined spaces
- Understand the elements of the confined space permit system
- Meet regulatory requirements.

2.0 OSHA's PERMIT-REQUIRED CONFINED SPACES STANDARD

The federal Occupational Health and Safety Administration (OSHA) has established specialized safety requirements, including a permitting system, for entry into all confined spaces which pose dangers to entrants as a result of space configuration and other features. The major provisions of the regulation, 29 CFR 1910.146, include:

- Identification of confined spaces (workplace evaluation and posting)
- Development of a permit-required confined space entry program
- Provision of a confined space entry permit
- Training and duties of authorized entrants
- Training and duties of authorized attendants
- Training and duties of entry supervisors
- Training and specialized equipment for rescue teams.

The OSHA regulation is intended to protect employees from those hazards of entry into, work within, and escape from, permit-required confined spaces in general industry. This rule does not apply to the following activities which are regulated by more specific standards:

- Agriculture or grain handling activities

- Construction (a specific OSHA standard is being developed)
- Shipyard employment.

2.1 Definitions

Following are definitions which will aid in the understanding of terms used in the confined space entry standard.

- Confined space: A space that meets all of the following criteria:
  - Is large enough and configured such that an employee can enter completely
  - Has limited or restricted means for entry and egress
  - Is not designed for continuous employee occupancy.

- Permit-required confined space: A confined space that has one or more of the following characteristics:
  - Contains or has a potential to contain a hazardous atmosphere
  - Contains a material with the potential to engulf the entrant
  - Is so configured that the entrant could be trapped or asphyxiated by converging walls or sloping floors
  - Contains any other recognized serious safety or health hazard.

- Attendant: A trained individual stationed outside of one or more permit spaces who monitors the authorized entrants in the confined space.

- Authorized entrant: An employee who is authorized by the employer to enter a permit space.

- Entry: The act by which an entrant intentionally passes through an opening into a permit space. Entry includes ensuing work activities conducted in a space and is considered to have occurred if any part of the entrant's body breaks the plane of an opening into the space.

- Entry permit: A written or printed document provided to allow and control entry into a permit space. The entry permit contains information relating to hazard identification and evaluation, isolation, monitoring requirements, personal protective equipment requirements, etc.

- Entry supervisor: An employee who has overall responsibility for a confined space, including the completion and signing of the confined space permit.

- Flammable range: Concentrations above the LEL and below the UEL which will explode if ignited with a source of sufficient energy.

- Hazardous atmosphere: An atmosphere is considered hazardous if it exposes an entrant to a risk of death, incapacitation, impairment of ability to self rescue (i.e.,

escape unaided from a permit space), injury, or acute illness, or the risk of death from one or more of the following causes:

- Flammable gases, vapors, or mists in excess of 10% of its lower explosive or flammable limit (LEL or LFL)
- Airborne combustible dust at a concentration that meets or exceeds its LFL [Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of five feet or less.]
- Oxygen deficient (<19.5%) or oxygen enriched (>23.5%) atmospheres
- Atmospheric concentrations of chemicals for which OSHA has established permissible exposure limits (PELs) or short term exposure limits (STELs) that could result in the entrant being exposed to conditions in excess of those limits

  [Note: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self rescue, injury, or acute illness due to its health effects is not covered by this provision.]

- Any other atmospheric condition recognized as immediately dangerous to life or health (IDLH).

- Hot work: Any work involving cutting, burning, welding, brazing, riveting, drilling, grinding, blasting, or other activity that produces or has the potential to produce sparks, static electricity, fire, or other sources of ignition.

- IDLH: Immediately dangerous to life or health (IDLH) means 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.

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

- LFL or LEL: The lower flammable/explosive limit is the minimum concentration of a flammable gas or vapor, expressed in percent volume, that will ignite given an ignition source of sufficient energy. The specific OSHA standard contains other pertinent definitions and should be reviewed for further information.

- UEL: The upper explosive limit (UEL) is the maximum concentration of a flammable gas or vapor in air that will propagate flame on contact with an ignition

source. Concentrations above the UEL are too rich to support combustion and will not ignite.

3.0 CONFINED SPACE IDENTIFICATION

Generally speaking, confined spaces are enclosed or semi-enclosed spaces having:

- Limited means of entry and exit, by reason of location, size, configuration, number of openings
- Unfavorable ventilation which could contain or contribute to the production of dangerous air contaminants
- Flammable or explosive atmospheres, and/or oxygen deficiencies and enrichments

Confined spaces are not designed for continuous worker occupancy.

3.1 Identification Methods

Refer to the OSHA Standard 29 CFR 1910.146, Appendix A - Permit Required Confined Space Decision Flow Chart, to facilitate the workplace survey to identify continued spaces.

3.2 Examples of Confined Spaces

Confined spaces could also be categorized as those with open tops and with a depth that restricts natural air movement, and enclosed spaces having limited openings for entry and exit. Examples of confined spaces routinely encountered in industry include, but are not limited to:

- Storage tanks
- Water tanks
- Sewers
- Crawl spaces
- Silos
- Baghouses
- Excavations/trenches
- Boilers
- Furnaces
- Manholes
- Pipelines
- Tunnels
- Tank cars/trucks
- Elevator pits.

Activities which may be conducted in confined spaces include, but are not limited to:

- Cleanup
- General maintenance
- Repair
- Welding/burning
- Painting
- Inspections.

3.3 Hazard Evaluation

In addition, confined spaces should be re-evaluated whenever there are changes in the use of the space, the configuration of the space, or when hazards change.

The following should be evaluated or re-evaluated for each confined space:

- Past, current, and future use of, and possible operations within, the space
- Physical characteristics, configuration, and location of the space
- Any known mechanical hazards within or outside the space that could affect operations
- Existing or potential atmospheric hazards within the space including:
  - Oxygen deficiency or enrichment
  - Flammable/explosive materials
  - Toxic chemicals.

The hazards identified in confined spaces should be evaluated based on the following:

- Magnitude and scope of exposure
- Likelihood of occurrence
- Potential for changing conditions or contributing to the existing hazards
- Control techniques
- Impact on emergency services.

3.4 Signage/Postings

If the workplace contains permit spaces, the employer must inform employees by posting danger signs, or via another equally effective means, of the existence and location of confined spaces and their associated dangers. Examples of postings which could be used are shown in Appendix A.

[Note: If employers decide employees will not enter confined spaces, they must take effective measures to prevent employee entry].

4.0 PERMIT-REQUIRED CONFINED SPACE ENTRY PROGRAM

This section provides a description of OSHA's permit-required confined space entry program as well as EPA specific program requirements.

4.1 Elements of OSHA's Permit-Required Confined Space Regulation

A confined space entry permit program is a written document describing how permit-required confined spaces are managed. The entry program includes provisions for the following:

- Permit space identification
- Methods for preventing unauthorized entry
- Hazard identification, evaluation, and control
- Permit system including preparation, issuance, use, and cancellation
- Identification of roles and responsibilities
- Employee training
- Rescue and emergency procedures
- Personal protective equipment and confined space equipment
- Contractor activities
- Review of the permit-required confined space program.

When an employer has chosen to establish alternative procedures, the procedures must ensure:

- Monitoring and inspection data is available to support the use of alternative procedures
- Conditions which make it unsafe to remove entrance covers are eliminated and guards are installed to protect openings
- Atmospheric monitoring is conducted prior to and periodically during entry
- Properly installed, continuous forced air ventilation is used
- When a hazardous atmosphere is detected during entry, employees leave the space immediately and an evaluation is made to determine how the hazard developed
- Written certification is maintained that documents the basis for determining that the confined space hazards have been eliminated.

4.2 EPA's Confined Space Entry Program

EPA draft Order 1450.4 Permit-Required Confined Space Operations establishes the requirements for the protection of employees operating in confined spaces and prescribes the basic policy, responsibilities, authority, and general operational instructions, including provisions for the following:

- EPA Confined Space Entry Program
- Responsibilities of Director, Safety, Health and Environmental Management Division
- Responsibilities of Regional or Program Designated Safety, Health and Environmental Management Officials
- Responsibilities of Safety, Health, and Environmental Management Program Managers
- Responsibilities of Entry Supervisors

- Responsibilities of Employees
- Requirements and Safe Operating Procedures
- Atmospheric Testing and Monitoring
- Emergency Rescue
- Training.

For additional details on EPA's Confined Space Entry Program, refer to Appendix B.

4.3 Training

Operations-specific training must be offered to affected employees, including employees entering spaces, attending spaces, providing rescue and emergency services, or serving as entry supervisors.

Training must be provided:

- Upon initial assignment
- When there is a change in the assigned duties
- Whenever there is a change in the permit space operations that presents a new hazard
- Whenever the employer has reason to believe that there are program deviations or inadequacies in the employee's knowledge or use of the procedure.

The training must establish employee proficiency in required duties (e.g., entry supervisor, authorized entrants, attendants) and provide employees with the understanding, knowledge, and skills necessary to safely perform confined space entry activities.

At a minimum, training must include:

- Specification of duties for authorized entrants, attendants, and authorizing individuals
- Hazard recognition
- Communications
- Safety and protective equipment
- Rescue procedures and practice sessions
- Use of atmospheric testing and monitoring equipment
- Safe operating procedures
- Isolation or lockout-tagout procedures.

The employer must certify completion and competency of confined space entry training. The certification must include the employee's name, signature or initials of the trainers, and dates of training. Training records will be kept by the SHEMP Manager for a minimum of one year.

4.4 Duties and Responsibilities

The following are duties and responsibilities for authorized entrants, attendants, entry supervisor, rescue and emergency services, and contractors.

4.4.1 Authorized Entrants

Employees assigned to work in permit spaces require formal classroom and hands-on training and must demonstrate proficiency in the following areas prior to working within a permit space:

- Hazard recognition:
  - Types of hazards
  - Modes of exposure
  - Signs and symptoms of exposure
  - Consequences of exposure

- Proper use of personal protective equipment:
  - Types of equipment (e.g., clothing, respirators, fall protection devices)
  - Inspection of equipment
  - Use of equipment
  - Limitations of equipment
  - Maintenance of equipment

- Communication with the attendant:
  - Operation of communications equipment (e.g., intrinsically safe two-way radios)
  - Hand signals and other non-verbal methods of communication
  - Permit-space communication policies
  - Entrant-initiated evacuation procedures (e.g., self-rescue)

- Alert the attendant and exit the space whenever a warning sign or symptom of exposure to a dangerous situation is recognized or a prohibited condition is identified, or an evacuation alarm is activated

- Proper use of safety equipment:
  - Testing and monitoring equipment
  - Ventilation equipment
  - Communications equipment
  - Lighting equipment
  - Rescue and emergency equipment
  - Entry/exit equipment

- Understand and implement required measures for work control:
  - Isolation techniques
  - Cleaning and purging

- Ventilation techniques.

4.4.2 Attendant

Employees assigned to monitor work within a confined space must have the training and knowledge necessary to perform the following duties:

- Hazard identification:
  - Types of hazards
  - Mode of exposure
  - Signs, symptoms, and behavioral effects of exposure
  - Consequence of exposure

- Remain outside the space during entry operations until relieved by another attendant

- Continuously maintain an accurate count of authorized entrants in the confined space

- Communicate with authorized entrants using equipment/techniques specified on the entry permit

- Monitor activities inside and outside the space

- Order entrants to evacuate the space immediately when any of the following occurs:
  - Identification of a prohibited condition
  - Detection of behavioral effects of hazard exposure, or detection of an uncontrolled hazard in the space
  - Detection of a situation outside of the space that could endanger the entrants
  - If the attendant must leave the work station

- Emergency procedures:
  - Summon emergency or rescue services as soon as the attendant determines the entrant's need to escape from the space.
  - Perform non-entry rescue as specified by the rescue procedure.

- Take the following actions when unauthorized persons approach or enter the confined space while entry is underway:
  - Warn unauthorized persons that they are restricted from the confined space work area.
  - Advise unauthorized entrants that they must immediately exit the space.
  - Inform authorized entrants and entry supervisors of an unauthorized entry.

- Refrain from interfering with monitoring the confined space.

4.4.3 Entry Supervisor

Entry supervisors should have adequate training to satisfy the following requirements:

- Hazard identification:
  - Types of hazards
  - Mode of exposure
  - Signs, symptoms, and behavioral effects of exposure
  - Consequence of exposure

- Ensure that the permit is complete and accurate

- Ensure all pre-entry requirements of the permit have been met prior to endorsing the permit, including:
  - Performance of required atmospheric testing
  - Use of proper personal protective equipment and safety equipment
  - Use of appropriate procedures and control measures

- Verify that rescue services are available and the means for summoning them are operable

- Remove unauthorized individuals who enter or attempt to enter the permit space during entry operations

- Verify that entry operations remain consistent with the entry permit and that acceptable entry conditions are maintained at intervals dictated by the hazards of the operation

- Terminate operations and cancel the permit based on changing conditions or completion of entry activities.

4.4.4 Rescue and Emergency Services

Per EPA draft policy, emergency rescue must be performed by a team comprised of non-EPA employees (i.e., contractors or outside local services), unless the EPA employees are specifically trained in emergency rescue techniques, including:

- Proper use of personal protective equipment and rescue equipment necessary for making rescues from permit spaces
- Assigned rescue duties
- Authorized entrant training
- Making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, mannequins, or actual persons from the actual permit spaces or from representative permit spaces. Representative spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed
- Basic first aid and CPR training (at least one member of the rescue service holding current certification in first aid and in CPR shall be available at all times).

If the employer arranges to use an outside rescue service, they shall:

- Inform the rescue service of hazards they may confront while performing confined space rescues on site
- Provide the rescue service with access to all permit spaces so that they can develop appropriate rescue plans and practice rescue operations.

4.4.5 Contractors

Potential problems exist when contractor personnel conduct work in permit spaces without being adequately informed of confined space hazards and procedures.

Contractors must be notified of all required site-specific arrangements for confined space entry including:

- The existence and hazards of confined spaces

- Precautions and procedures for confined space entry:
  - Permit-required confined space program
  - Permit system
  - Emergency procedures

- Coordinating entry operations with the contractor when both plant employees and contractor personnel will be working in or near a confined space

- Debriefing the subcontractor at the conclusion of entry operation.

In addition to complying with the permit space requirements that apply to all employees, each contractor shall:

- Obtain any available information regarding permit-required space hazards and entry operations from the employer

- Coordinate entry operations with the employer when both plant personnel and contractor personnel will be working in or near permit-required spaces

- Inform employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operations.

5.0 CONFINED SPACE PERMIT SYSTEM

The permit system is the method by which employers authorize work in confined spaces. The permit is a standardized form through which confined space hazards are evaluated and controlled to ensure safe entry into, and work within, a permit space.

5.1 Permit Information

The permit must include, at a minimum, the following:

- Identification/location of permit space
- Purpose of entry
- Date of entry and authorized duration
- List of authorized entrants
- List of authorized attendants
- Name and signature of the entry supervisor
- Hazards present in the permit space
- Hazard control and isolation techniques
- Acceptable entry conditions
- Results of initial and periodic atmospheric testing and monitoring, the name/initials of the tester and the time the tests were performed
- Rescue and emergency services
- Entrant/attendant communication procedures and equipment
- Required equipment:
  - Personal protection equipment
  - Testing equipment
  - Alarm systems
  - Communication equipment
  - Rescue equipment
- Any additional permits (e.g., hot work) that have been issued to authorize work in the confined space.

5.2 EPA's Confined Space Permit

As part of EPA's draft Order 1450.4, a sample confined space entry permit was developed and is attached as Appendix C. The permit covers the following items:

- General information (e.g., project, purpose for entry, description of confined space)
- Personnel information
- Pre-entry preparation (e.g., anticipated hazards, confined space isolated/prepared, atmosphere pre-tested, safety equipment)
- Special requirements (e.g., continuous/periodic monitoring, forced/exhaust ventilation)
- Rescue plan
- Permit authorization.

5.3 Evaluation of the Confined Space Permit Program

In order to ensure continued effectiveness of and compliance with the permit-required confined space entry program, an annual evaluation or review of the program must be conducted. Employers may perform a single annual review covering all entries performed

during a 12 month period. If no entry is performed during a 12-month period, no review is necessary.

Canceled entry permits must be retained for at least one year to facilitate the review. Any problems encountered during entry operations must be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

6.0 CONFINED SPACE HAZARDS

There are many hazards associated with confined space entry. This section provides an overview of how to recognize hazards including: atmospheric, mechanical, electrical, physical, and others.

6.1 Hazard Recognition

The majority of confined space injuries result from a failure to recognize hazards. Workers entering confined spaces are faced with multiple hazards which can include atmospheric hazards, mechanical hazards and physical hazards. These hazards can be present in a space prior to entry, produced as a result of some activity conducted in the space, or brought into the space by the entrant. Proper hazard recognition will help to ensure that the proper precautionary measures are taken to adequately protect the confined space worker.

6.2 Atmospheric Hazards

This section provides a description of the following atmospheric hazards that may be encountered during confined space entry:

- Flammable atmospheres that can arise from the following:
  - Presence of flammable gases (e.g., hydrogen, propane, methane)
  - Vaporization of flammable liquids (e.g., toluene, xylene, acetone)
  - Byproducts of work (e.g., spray painting, welding, cutting)
  - Chemical reactions (e.g., pyrophoric compounds such as carbon, iron, and ferrous oxides found in tanks used by chemical and petroleum industries)
  - Concentrations of combustible dusts (e.g., coal dust)
  - Desorption of chemicals from walls of the space (e.g., liquid propane vessel)
  - Oxygen enriched atmospheres (e.g., reactions that liberate oxygen, improperly using oxygen for continuous ventilation)

- Toxic atmospheres that can arise from the following:
  - The product stored in the space (e.g., hydrogen sulfide is a toxic byproduct of the decomposition reaction of many organic materials)
  - Operations performed in the space (e.g., painting, welding, brazing, cleaning with solvents)

- Desorption of chemicals from the space (e.g., desorption from walls, wall scale, sludge)
- Reactions between new product and residual amounts of previous products stored in the space
- Accumulation of toxic substances in the space from sources outside the space

- Oxygen deficient or asphyxiating atmospheres can arise from the following:
  - Operations consuming oxygen (e.g., welding, cutting, brazing)
  - Reactions consuming oxygen (e.g., fermentation processes, formation of rust)
  - Oxygen displacement by purging agents (e.g., carbon dioxide, helium, nitrogen)
  - Natural evolution and accumulation of oxygen displacing gases from outside the space (e.g., carbon dioxide, argon, helium)

- Irritating atmospheres can be created by many other chemicals common to industrial activities (e.g., chlorine, ammonia, mineral acids, benzene, carbon tetrachloride, chloropropane).

6.3 Mechanical and Electrical Hazards

Mechanical and electrical hazards present the risk of physical entrapment and shock but also the potential for generating heat, sparks, and static electric charge which can ignite flammable atmospheres. Examples include:

- Belts
- Shafts
- Blades
- Improper bonding and grounding
- Non-explosion-proof tools, ventilation, and lighting equipment
- Static charge generation from blasting, grinding, and mechanical cleaning
- Non-spark resistant tools
- Frayed extension cords
- Poorly inspected tools and devices.

6.4 Physical Hazards

This section provides a description of physical hazards that may be encountered during confined space entry which include the following:

- Physical stressors associated with confined space work include:
  - Heat stress/cold stress
  - Noise
  - Vibration
  - Space configuration
  - Illumination

- Communications present an unusual hazard when working in confined spaces due to the following:
  - Noise
  - Space configuration
  - Location or size of entry hatch

  Note: When the attendant's view of the worker is obstructed, a worker under distress may not be able to summon help. When an obstructed view of the worker presents a significant hazard, a voice-activated communication system should be used.

6.5 Other Hazards

Other hazards associated with confined space entry include:

- External hazards
  - Contamination of ventilation air source by operation outside the space (e.g., painting, welding)
  - Unauthorized entrants

- Ionizing/non-ionizing radiation hazards.

7.0 EXPOSURE SIGNS AND SYMPTOMS

The symptoms of chemical exposure or asphyxiation depend on the chemical involved, concentration, duration of exposure, as well as the worker's sex, physical condition, age, and predisposition. The majority of confined space injuries result from acute exposures (e.g.,short-term exposures) to either toxic or asphyxiating atmospheres. Exposure to these atmospheres can result in death.

Symptoms of an acute exposure to a toxic atmosphere include:

- Headache
- Coughing
- Asthma
- Nasal inflammation/irritation
- Muscle cramps
- Pneumonia
- Respiratory irritation
- Loss of balance
- Skin irritation
- Shortness of breath
- Edema
- Dilated pupils
- Elevated pulse rate
- Unconsciousness.

Symptoms arising from exposure to an oxygen deficient atmosphere are described in Table 1.

Table 1: Symptoms Arising from Exposure to an Oxygen Deficient Atmosphere

Oxygen Contained In Air	Symptoms
23.5%	Highest "Safe" Level, concentrations >23.5% are considered oxygen enriched and increase potential risk of fire.
21%	Normal atmospheric concentration.
19.5%	Lowest "Safe" Level per OSHA.
15%-19%	Impaired coordination and decreased ability to sustain strenuous work load. Symptoms resemble early signs of coronary attack.
12%-14%	Deep respiration, increased pulse rate and impaired coordination, perception, judgment.
10%-12%	Increased respiration, giddiness, poor judgment, and bluish lips.
8%-10%	Nausea, vomiting, unconsciousness, and ashen face.
6%-8%	Recovery with treatment after 4-5 minutes, 50% fatal after 6 minutes, and 100% fatal after 8 minutes.
4%	Convulsions, cessation of respiration, coma in 40 seconds, and death within minutes.

- Entry is prohibited if the concentration of flammable gases or vapors is >10% of the LEL
- Entry is allowed in IDLH atmospheres if qualified personnel are equipped with SCBAs*.

  * *Full facepiece, pressure demand/positive pressure mode airline respirators with egress bottles or similar SCBAs.*

8.0 HAZARD EVALUATION

Entry into a confined space is prohibited until initial testing of the atmosphere has been completed from outside the space. The atmosphere inside the space should be tested for oxygen content, flammability, and any toxic components. These tests serve as a minimum for pre-entry testing. Other tests may be necessary based on known or suspected hazards present in the space. Entry into a space containing one or more of the following "hazardous atmospheres" is prohibited without proper protective equipment:

- Entry is strictly prohibited if the concentration of oxygen is <19.5% (Entry is allowed where personnel are equipped with SCBAs*)
- Entry is strictly prohibited if the concentration of oxygen is >23.5%.

8.1 Testing

Since gases and vapors have different vapor densities (i.e., weight relative to air), they will concentrate in different spatial areas within a permit space. For example, methane has a vapor density less than air and will accumulate in high areas within a space; hydrogen sulfide has a vapor density greater than air and will settle into low areas in a space. As much of the space as possible should be characterized during the initial testing exercise. Testing should be performed, whenever possible, using remote sampling devices. There is always a possibility that a space may need to be entered to be tested more thoroughly.

Atmospheric testing is required for two distinct purposes: evaluation of permit space hazards and verification that acceptable confined space entry conditions exist.

The industrial hygienist, safety engineer or other qualified technician testing the space must ensure that only intrinsically safe testing equipment is used, and that the equipment is calibrated, inspected, and used correctly. Initial atmospheric monitoring is required to verify that acceptable entry conditions exist prior to entry. When testing for atmospheric hazards, first test for oxygen, then for combustible gases and vapors, and finally for toxic gases and vapors. (Note: Some meters monitor all gases simultaneously). The following areas should be tested prior to classifying the atmosphere in a confined space:

- Access openings (e.g., manways, tunnels)
- Incremental elevations
- Bottom
- Corners
- In and around pipelines
- Under and behind structural supports, deep frames, and swash plates.

Requirements for continuous and spot testing, and retesting after breaks or shift changes will be specified by the entry supervisor in the permit. Special testing requirements based on the configuration of the confined space should also be specified in the entry permit.

Always remember, test results are valid for one location, in one space, and only for the duration of the test itself. Tests should be repeated if any conditions change within the space, and prior to re-entering a space after a shift change or at the beginning of a new day.

The three primary types of air monitoring instruments used to characterize atmospheres within confined spaces are: oxygen meters, combustible gas meters, and toxic atmosphere monitors. To be useful, any air monitoring equipment should have the following features:

- Portability
- Ease of operation and calibration
- Generation of real-time data
- Durability
- Intrinsic safety
- Both visual and audible alarms.

Types of monitoring instruments which may be used include:

- Combustible gas meter
- Oxygen meter
- Hydrogen sulfide(H_2S) meter
- Carbon monoxide (CO) meter
- Multi-gas meters
- Colorimetric tubes
- Photoionization detectors
- Flame ionization detectors
- Other gas-specific meters.

The following section discusses what the various sensors in a multi-gas meter can and cannot do.

8.2 Oxygen Meters/Sensors

The oxygen sensor is used to determine the following:

- Oxygen content for respiratory purposes: Normal air contains approximately 21% oxygen; if oxygen content is below 19.5%, air-supplied respiratory equipment is necessary.

- Increased risk of combustion: Oxygen concentration in excess of 23.5% is considered oxygen-enriched and increases the risk and energy of combustion.

- Use of other instruments: Many instruments, including combustible gas indicators require sufficient oxygen for proper operation. Additionally, the inherent safety approvals given for instruments are not valid in oxygen-enriched atmospheres.

- Presence of other contaminants: A decrease in the oxygen content in an atmosphere can be due to the consumption of oxygen through rusting, corrosion, and or other chemical reactions, or by displacement of oxygen by another substance. On a quantitative basis, a 1% decrease in oxygen content is equal to a possible 10,000 ppm of a toxic contaminant.

Oxygen sensor features include the following:

- Variable response time, based on temperature, length of sampling probe/line, instrument manufacturer, etc.
- Specific, quantitative response
- Variety of scales: normally 0%-25% (usually includes a decimal point; e.g., 19.8%)
- Manual aspirating bulb, internal pump, or passive flow
- Audible and visible alarms
- Extension probes, wires, and hoses for remote sampling.

Oxygen sensor limitations include the following:

- Must be calibrated in 20.8% oxygen atmosphere
- Must be calibrated at elevation of expected use
- High concentrations of carbon dioxide shorten life of sensor
- Temperature can affect response, normal operating range is 32°F-120°F. Must be calibrated at expected use temperature. Some sensor's response time increases as temperature decreases and the sensor will not function below 32°F
- Strong oxidizing chemicals like ozone and chlorine can cause increased meter response.

8.3 Combustible Gas Indicators/Sensors

Combustible gas indicators (CGI) have a sensor which measures the concentration of flammable gases and vapors in an atmosphere. The results are indicated as a percentage of the LEL of the atmosphere relative to the gas against which the meter was calibrated.

Three types of responses can be indicated on a CGI. Proper interpretation of the responses is essential to correctly classifying the atmosphere. The following interpretations apply to a CGI having a 0%-100% scale:

- <LEL: Atmospheres below the LEL will be indicated by the meter needle responding less than 100% of the full scale reading.

- ≥ LEL and ≤UEL: Atmospheres within the flammable range will be indicated by the meter needle remaining above full scale.

- >UEL: Atmospheres above the UEL will be indicated by the meter needle rising to above the full-scale reading and then returning to some arbitrary position below the full scale. Care must be taken when monitoring atmospheres in the upper regions of the flammable range to ensure that >UEL conditions are properly classified.

- Digital readouts will show a three-digit number in excess of 100% when one has exceeded the LEL.

Features of the combustible gas indicator include the following:

- Rapid response
- Non-specific (e.g., will not identify flammable components)
- Qualitative (e.g., relative to the calibration gas)
- Audible and visible alarms
- Various scales
- Extension probes and hoses for remote sampling
- Manual aspirating bulb, internal bulb, or passive flow.

Limitations of the combustible gas indicator include the following:

- Most require at least 10% oxygen content in the atmosphere for proper operation
- Responses are non-specific (e.g., relative to the calibration gas)
- Must be calibrated at expected use temperature. Elevated temperatures increase responses, decreased temperatures depress responses
- Must be calibrated at expected use humidity. Elevated humidities depress responses
- Organic lead vapors, acid gases, sulfur compounds, and silicone compounds can damage the sensor.

8.4 Toxic Atmosphere Monitors/Sensors

Toxic atmosphere monitors include a wide variety of meters and detectors such as colorimetric indicator tubes, organic vapor analyzers, photoionization detectors, flame ionization detectors, aerosol monitors, and other chemical specific gas monitors (e.g., H_2S, and CO, SO_2,).

Colorimetric tubes provide a simple, inexpensive method for analyzing confined space atmospheres. A detector tube consists of a glass tube containing a silica gel which has been impregnated with a color-indicating agent. The tube is connected to a piston or bellows pump, and a known volume of air is drawn through the tube at a predetermined rate. The contaminants in the air react with the indicating chemical to produce a color change otherwise known as a length of stain. The length of stain is roughly proportional to the concentration of contaminants in the air.

Features of colorimetric detector tubes include the following:

- Chemical or chemical class-specific
- Several concentration ranges available on many tubes
- Give immediate results
- Have extension hoses for remote sampling
- Have manual or mechanical systems.

Limitations of colorimetric detector tubes include the following:

- Instructions/directions must be carefully followed to ensure proper use of indicating tube and interpretation of results
- Variable accuracy and precision based on tube used primarily for qualitative and semi- quantitative measurements
- Some tubes respond to other interfering chemicals
- Tube responses affected by temperature. Low temperatures depress responses and high temperatures increase responses
- Tubes from one manufacturer cannot be used with pumps from another manufacturer
- Some tubes are affected by high humidity
- Tubes have a limited shelf life
- Time consuming; some tubes require significant sample volumes resulting in analysis times of up to 30 minutes

- Interpretation of results can be difficult due to channeling of the length of stain as a result of non-uniform packing of the silica gel and due to subtle color changes.

Refer to "Air Monitoring" for additional information on air monitoring instruments and methods.

9.0 HAZARD CONTROL

Controlling the hazards identified during the inspection and testing phases of confined space entry can take the following forms:

- Physical barriers and signs
- Isolation
- Ventilation
- Purging and cleaning.

9.1 Barriers and Signs

Physical barriers outside a permit space serve to increase the awareness of workers working in proximity of the permit space and are an effective method of controlling external hazards. The following items can serve as effective barriers:

- Cones
- Warning signs
- Barrier tape
- Warning lights
- Barrier rope
- Flags
- Sawhorses
- Warning drums
- Net fencing
- Security personnel.

9.2 Isolation

Isolation is a process whereby a permit space is removed from service and protected against the inadvertent release of materials by one or more of the following techniques:

- Blanking pipelines into the space
- Double block and bleed
- Lockout/tagout of electrical equipment and other energy sources
- Removing valves or physically misaligning and capping pipelines leading into the space
- Blocking, disconnecting, and securing mechanical devices and linkages, belts, gears, and chains.

9.3 Ventilation

Ventilation of a permit space by natural flow or a mechanical blower or fan may be necessary in order to maintain acceptable atmospheric conditions when there is an oxygen deficiency, excess oxygen, or when flammable or toxic gases/vapors are present. Ventilation requirements will be prescribed on the entry permit. The equipment and techniques used to ventilate a permit space depend on the following:

- Size and number of the openings in the space
- Configuration of space
- Gases and vapors to be exhausted
- Work to be performed in space
- Source of makeup air.

Begin ventilating well in advance of entry operations and test the atmosphere prior to entry. After entry, continue ventilation while personnel are in the space. Regular testing or continuous monitoring is needed to ensure that acceptable atmospheric conditions are maintained. If the ventilation system shuts down, personnel shall leave the space and not re-enter until ventilation is reestablished. Two general types of air moving devices used to ventilate confined spaces are fans and air horns (vaneaxial ventilators, venturi blowers, etc.). Trunk hoses are often used to increase the efficiencies of air moving devices.

9.3.1 General Ventilation

General ventilation (blowing), or dilution via blowing, is used when toxic atmospheres are produced as a result of work operations, or as a result of the nature of the space. The concept of general ventilation is to distribute the contaminants from a local area throughout the space to maximize dilution. General ventilation does not reduce the amount of contaminants released, so it cannot be used in every situation. Continuous ventilation can be used to control the following environments:

- Painting operations
- Desorption of chemicals from walls of space
- Volatilization of residual chemical in space
- Oxygen deficient atmospheres
- Welding, cutting, and grinding operations (local exhaust ventilation is usually the preferred method).

General ventilation is most effective when:

- Personnel are not close to the source of contamination
- The concentration of contaminants is low
- The contaminants are not highly toxic
- Contaminants are produced at a relatively uniform rate.

9.3.2 Local Exhaust Ventilation

Local exhaust ventilation (i.e., sucking) is used when general ventilation has proven ineffective in controlling the atmosphere due to the physical restrictions of the space or high concentrations of contaminants in the breathing zone. Local exhaust ventilation is the best way to control flammable and toxic materials produced at a single point. Local exhaust ventilation is used to control the following environments:

- Painting operations
- Welding, cutting, and grinding operations
- Chemical cleaning operations.

It is important to keep the exhaust intake close to the work for maximum efficiency.

Local exhaust ventilation is not effective when contaminants are widely dispersed. In addition, the location or size of the space can make this type of ventilation difficult to use.

9.3.3 Exhaust Ventilation

The following precautionary measures apply to all ventilation and exhaust operations:

- Use compressed air, never pure oxygen
- Only explosion-proof equipment should be used in flammable or potentially flammable atmospheres
- All equipment should be bonded and grounded
- Only air- or steam- (not oxygen-) driven equipment are recommended, however, intrinsically safe devices can also be used
- The air supply for continuous forced air ventilation shall be from a clean source and may not increase the hazards within the space, and shall be positioned to ventilate the immediate area where personnel will be working
- Contaminated air should be exhausted to a safe area away from source air to prevent recirculation and endangering nearby personnel
- Place the exhaust and inlets so that the fresh air is not drawn directly into the exhaust to avoid short circuiting
- Exhaust and inlets should be placed far enough away to avoid jetting
- Controls for ventilation equipment should be located at a safe distance from the space
- The effectiveness of ventilation procedures should be monitored using either continuous or spot testing.

Ventilation must provide circulation of fresh air through all areas of the space. There are three common pitfalls to watch out for:

- Recirculation
- Short Circuiting

- Jetting.

Ventilation systems must be properly installed to avoid recirculation, short circuiting and jetting. The following techniques apply:

- Use equipment with adequate power
- Allocate fresh air inlets and exhaust outlets. Ideally, incoming and exhaust air should move through separate openings, located far apart
- Install ductwork for efficiency:
  - Avoid sharp bends
  - Keep ducts as short and straight as possible
  - Ensure that connections are tight
  - Locate ducts so that they won't be damaged during confined space activities.

9.4 Cleaning and Purging

Procedures and techniques used to clean or purge a permit space will be determined by the entry supervisor and will be specific to the product held in the space. The following precautions apply:

- Initial cleaning of any space should be conducted from outside the space if possible
- Based on the conditions, spaces containing flammable products must be purged with an inert gas (e.g., CO_2, helium, nitrogen) prior to cleaning
- Spaces cleaned with steam must be allowed to cool prior to authorizing entry
- Pipes and nozzles of steam hoses should be bonded to the space
- Steaming should not be used as a cleaning method when the auto ignition temperature of the stored product is 120% or less of the steam temperature
- Continuous ventilation should be used when using chemical cleaning processes
- Cleaning and purging activities should be reviewed for environmental implications as necessary.

10.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) is used to protect or isolate a worker from an impending hazard. The types of hazards present in a permit space that require PPE fall under the following categories:

- Physical Hazards
  - Noise
  - Sharp objects
  - Overhead structures
  - Foot level structures and equipment
  - Heat
  - Electrocution
  - Sparks

- Space configuration
- Facial impact

- Chemical Hazards
  - Liquid splashes to eyes, face, and body
  - Gases/vapors
  - Dusts, mists, fumes, smoke, etc.

- Radiation Hazards.

The PPE used to protect a worker must be matched to the physical or chemical hazards present. The entry supervisor and the safety and health representative will assign the appropriate PPE for a particular confined space operation. Hazard assessment, exposure duration and scenario, equipment performance and limitation, impact on worker performance, and worker compliance must all be considered when selecting the most appropriate PPE.

10.1 Respiratory Protection

Respiratory protection will be selected by the entry supervisor and the safety and health representative based on the conditions and test results of the permit space, the configuration of the space, and the work activity to be conducted. Two types of respiratory equipment are used in confined space work: air purifying respirators, and supplied air respirators.

10.1.1 Air Purifying Respirators

Air purifying respirators (APRs) offer the advantages of light weight, low impact on worker performance and full mobility. APRs have limited application to confined space operations since they can only be used when all of the following conditions are met:

- At least 19.5% oxygen is present
- Atmosphere must be completely characterized (i.e., known contaminants) to select appropriate cartridge or canister
- Cartridge must be available for contaminants
- Contaminants must exhibit adequate warning properties
- Concentration of contaminant must be within the usable range of the APR, based on the performance factor of the specific type of respirator (e.g., $\leq$ 50 x PEL for a full face APR).

10.1.2 Supplied Air Respirators

Supplied air respirators (SARs) provide the worker with a controlled source of air from either a station system (air-line respirator) or a portable system (self-contained breathing apparatus; SCBA). SARs offer the benefits of a constant and controlled supply of

breathing air and increased protection allowing workers to enter areas as high as 10,000 x PEL.

Following are the benefits and disadvantages of air-line respirators:

- Benefits
  - Extended air supply
  - Controlled air supply
  - Lighter weight than an SCBA
  - Multi-user
  - Low pressure alarm

- Disadvantages
  - Potential damage/contamination to airline
  - Limited mobility (maximum of 300 feet)
  - Air supply must be outside of space
  - Air supplied by compressor or cylinders must be monitored to meet Compressed Gas Association minimum Grade D requirements
  - Cannot use in IDLH atmosphere without an emergency escape air supply.

Following are the benefits and disadvantages of a self-contained breathing apparatus:

- Benefits
  - Complete mobility
  - Controlled air supply
  - Entry into IDLH atmosphere

- Disadvantages
  - Heavy relative to airline respirators
  - Limited air supply (rated at 30 to 60 minutes, but use varies with individual)

A relatively new type of respiratory protection is available which utilizes a dual regulator, giving the user the automatic option of airlines or self-contained air supplies.

For more information, refer to "Respiratory Protection."

10.2 Eye and Face Protection

Eye and face protection is required during confined space work to protect workers against hazards such as:

- Flying particles from grinding, cutting, or scraping operations
- Chemical splashing during painting, cleaning, scrubbing operations
- Sparks from welding, brazing, and cutting operations.

The following types of eye and face protection are often used in confined space work:

- Safety glasses with side shields
- Goggles
- Face shields (plastic or mesh)
- Full-face respirators (SCBA)
- Hoods (chemically resistant or abrasive blasting).

10.3 Head Protection

Overhead hazards are prevalent during confined space work and rescue operations. Hard hats are required to protect employees from impact hazards resulting from falling objects. Head protection should be provided where the potential exists for contact with low pipelines, beams or other obstructions. Head protection equipped with face shields or ear muffs is also available. A chin strap is particularly advantageous when work involves bending and ducking, and also helps to secure the hard hat to the head when full-face masks are worn.

10.4 Foot Protection

The major hazards associated with walking and working surfaces include both physical hazards (e.g., impact, cut, slash), and chemical hazards (e.g., corrosives, organics). Many configurations of foot protection exist, including the following:

- Steel-toed safety shoes and boots
- Polymer-toed safety shoes and boots
- Chemically-resistant boots
- Combination steel/polymer-toed chemically-resistant boots
- Chemically-resistant shoe and boot covers.

10.5 Hand Protection

The major hazards requiring hand protection include: vibration, cut/slash, heat, chemical and electrical hazards. All of the suspected hazards must be considered when selecting the proper hand protection. The following materials are used in the manufacture of hand protection for confined space work:

- Leather
- Stainless steel mesh
- Kevlar®
- Thermal-resistive composites
- Chemically-resistant materials, such as:
  - Polyvinyl chloride
  - Neoprene
  - Nitrile
  - Butyl
  - Natural rubber
  - Proprietary materials.

10.6 Body Protection

Hazards requiring body protection include: physical hazards (e.g.,flame, heat, impact), chemical hazards, and heat/cold stress. In general, all workers entering a confined space should wear full body protection which will be specified by the entry supervisor and the health and safety representative. The protection may or may not include chemically resistant clothing. When the potential exists for either cold or heat stress, the entry supervisor and the health and safety representative will recommend appropriate clothing and equipment (e.g.,personnel heating/cooling devices) and modifications to work practices to allow for rest periods and warm-up/cool-down times.

10.7 Hearing Protection

The hazards associated with noise are exacerbated when working in confined spaces due to the configuration of the work place. Hearing protection must be worn during high-noise operations. Audible alarms should be designed so that workers can interpret the alarms while wearing hearing protection devices. Hearing protection devices are classified as follows:

- Ear plugs
- Ear muffs.

For more information, refer to “Personal Protective Clothing and Equipment.”

11.0 CONFINED SPACE ENTRY EQUIPMENT

In addition to PPE, a variety of other specialized equipment is necessary to ensure worker safety while entering, working within, and exiting permit spaces.

A checklist or SOP should be used to ensure that preventative maintenance and inspections (before and after each use) are performed on confined space entry equipment and supplies.

11.1 Harnesses and Lifelines

Safety harnesses are systems of adjustable straps and buckles worn over and around the body to provide a secure method of extracting a worker from a confined space. The type of harness used depends on the hazards associated with the space.

Lifelines are used during rescue, when lowering workers into top entry spaces, and by workers entering spaces with side openings. Lifelines are not practical when:

- Internal structures (e.g., members, piping, equipment) restrict movement within the space such that a lifeline would be rendered useless

- The number of workers within the space is such that entanglement of the lines is possible.

Lifelines must be in 25-foot or longer sections of 3/4-inch manila or 1/2-inch dacron rope. The free end of the lifeline must be secured outside the permit space, to a mechanical device or fixed point. Additionally, all lifelines, ropes, and lanyards should be resistant to those chemicals they may come in contact with.

11.2 Wristlets

Wristlets are used in conjunction with a harness and consist of loops of strapping worn around the wrists which are connected to a lifeline. Wristlets are worn by workers for rescue purposes, when entering spaces with small <24-inch diameter entryways.

All safety harnesses, lifelines, and wristlets must be inspected prior to use. Equipment found to show any of the following signs of wear should be taken out of service and repaired or replaced:

- Unusual wear
- Corrosion
- Cuts
- Tears
- Severe abrasions
- Chemical degradation/contamination
- Distortion
- Cracking
- Pitting
- Rough/sharp edges
- Frayed ends.

11.3 Mechanical Lifting Devices

Hoists, winches and other lifting devices are used with top-entry spaces to aid in the retrieval of workers during rescue.

11.4 Ladders

Rope and collapsible and rigid ladders all find application in confined spaces. The selection of the appropriate type of ladder depends upon the size and configuration of the space. All ladders should be constructed of non-sparking materials, resist degradation by chemicals present in the space, be in good condition, and approved for the intended use. For more information, refer to “Ladders and Climbing.”

11.5 Ground-Fault Circuit Interrupt Devices (GFCI)

GFCIs are commonly used during confined space entry operations. A GFCI breaks a circuit when it detects levels of current leaking to ground. This fast-acting device minimizes the level and duration of the leak to minimize potential injuries due to electrical shock. For more information on control of hazardous energy, refer to "Hazardous Energy Sources and Mechanical Hazards."

11.6 Lighting Equipment

Adequate lighting is essential for safe work in permit spaces. Illumination should be great enough to minimize shadowing within the space. Matches or open-flame devices shall not be used as sources of illumination. All lighting equipment whether it be hand-held, stationary or head mounted should be shielded and explosion proof or low voltage.

11.7 Tools

Non-sparking, hand-powered or pneumatic tools are recommended for use in confined spaces having flammable or potentially flammable environments. Spark-resistant tools are fabricated from aluminum, brass, bronze, and beryllium copper. Ifelectrical tools are required, they should be low voltage, intrinsically safe, or explosion-proof.

11.8 Communication Devices

Communication between entrants and attendants can be accomplished using the following devices and methods:

- Two-way radios
- Oral communications
- Tug ropes
- Hand signals
- Pre-arranged check-in times
- Motion monitors
- Visible/audible alarms.

11.9 Emergency Equipment

Attendants may be required to have the following emergency equipment stationed outside the space based on the hazards present in the space, and expected hazards created as a result of the work mission:

- Full body harness and lifeline for use by rescue personnel
- First aid kit
- Fire extinguisher (for hot work)
- Emergency and rescue team telephone numbers

- Means for contacting rescue team (e.g., telephone, radio, horn)
- SCBAs.

12.0 SUMMARY

This module has discussed the following regarding confined space entry:

- OSHA's Permit-Required Confined Spaces Standard
- EPA’s policy on confined space entry
- Roles, responsibilities, and training requirements for authorized entrants, attendants, entry supervisors, rescue services, and the safety and health representative
- How to identify, evaluate, and post confined spaces
- How to use a variety of atmospheric testing devices
- How to select, use, inspect, and maintain specialized personal protective equipment and confined space equipment.

Steps you can take as an employee include:

- Be familiar with OSHA and EPA confined space regulations
- Understand the elements of the confined space permit system
- Ensure that you have received the appropriate training prior to engaging in confined space activities
- Understand the potential hazards associated with confined space activities
- Recognize the symptoms of exposure
- Have the appropriate protective confined space entry equipment available
- Know how to use protective and confined space entry equipment.

EXERCISE

Answer the following True or False.

1. _____ OSHA's permit-required confined space entry standard does not apply to construction activities.

2. _____ A confined space is not designed for continuous employee occupancy, is large enough and configured such that an employee can enter and has limited or restricted means of entry and egress.

3. _____ An atmosphere is considered hazardous if it exposes an entrant to risk from flammable gases, vapors, or mists in excess of 20% of its LEL or LFL.

4. _____ Confined spaces should be re-evaluated whenever there are changes in use of the space, configuration of the space, or when hazards change.

5. _____ Employees assigned to working permit spaces require formal classroom and hands-on training.

Choose the best answer for the following:

6. _____ Confined spaces routinely encountered in industry include:

    A. Sewers
    B. Silos
    C. Furnaces
    D. All of the above

7. _____ A confined space entry permit program includes provisions for the following:

    A. Training
    B. Identification of roles and responsibilities
    C. Hazard identification
    D. All of the above

8. _____ All but the following are confined space hazards.

    A. Natural
    B. Atmospheric
    C. Mechanical
    D. Physical

9. _____ Symptoms of an acute exposure to a toxic atmosphere can include all but the

following:

A. Asthma
B. Cramps
C. Vomiting
D. Headache

10. _____ Entry into a confined space with the following hazards is prohibited without proper protective equipment:

    A. Oxygen concentration <19.5%
    B. Flammable gas concentration ≥10% of LEL
    C. IDLH atmospheres
    D. All of the above

11. _____ When testing for atmospheric hazards, do so in the following order:

    A. Combustible gases and vapors, oxygen, toxic gases and vapors
    B. Oxygen, combustible gases and vapors, toxic gases and vapors
    C. Toxic gases and vapors, oxygen, combustible gases and vapors
    D. None of the above

12. _____ The primary type of air monitoring instruments used to characterize atmospheres within confined spaces are:

    A. Oxygen meters
    B. Combustible gas meters
    C. Toxic atmosphere monitors
    D. All of the above

13. List four methods of controlling hazards identified in a confined space:

    •
    •
    •
    •

14. Give five examples of physical and chemical hazards that may be present in a permit space that require PPE:

    •
    •
    •
    •
    •

15. List five examples of confined space entry equipment in addition to PPE:

-
-
-
-
-

EXERCISE KEY

Answer the following True or False.

1. ***T*** OSHA's permit-required confined space entry standard does not apply to construction activities.

2. ***T*** A confined space is not designed for continuous employee occupancy, is large enough and configured such that an employee can enter and has limited or restricted means of entry and egress.

3. ***F*** An atmosphere is considered hazardous if it exposes an entrant to risk from flammable gases, vapors, or mists in excess of 20% of its LEL or LFL.

4. ***T*** Confined spaces should be re-evaluated whenever there are changes in use of the space, configuration of the space, or when hazards change.

5. ***T*** Employees assigned to working permit spaces require formal classroom and hands-on training.

Choose the best answer for the following:

6. _____ Confined spaces routinely encountered in industry include:

    A. Sewers
    B. Silos
    C. Furnaces
    D. All of the above

7. _____ A confined space entry permit program includes provisions for the following:

    A. Training
    B. Identification of roles and responsibilities
    C. Hazard identification
    D. All of the above

8. _____ All but the following are confined space hazards.

    A. Natural
    B. Atmospheric
    C. Mechanical
    D. Physical

9. _____ Symptoms of an acute exposure to a toxic atmosphere can include all but the following:
    A. Asthma

B. Cramps
C. Vomiting
D. Headache

10. _____ Entry into a confined space with the following hazards is prohibited without proper protective equipment:

A. Oxygen concentration <19.5%
B. Flammable gas concentration ≥10% of LEL
C. IDLH atmospheres
D. All of the above

11. _____ When testing for atmospheric hazards, do so in the following order:

A. Combustible gases and vapors, oxygen, toxic gases and vapors
B. Oxygen, combustible gases and vapors, toxic gases and vapors
C. Toxic gases and vapors, oxygen, combustible gases and vapors
D. None of the above

12. _____ The primary type of air monitoring instruments used to characterize atmospheres within confined spaces are:

A. Oxygen meters
B. Combustible gas meters
C. Toxic atmosphere monitors
D. All of the above

13. List four methods of controlling hazards identified in a confined space:

Physical barriers and signs, isolation, ventilation, purging and cleaning.

14. Give five examples of physical and chemical hazards that may be present in a permit space that require PPE:

Refer to lists in Section 10 "Personal Protective Equipment."

15. List five examples of confined space entry equipment in addition to PPE:

Harnesses and lifelines, wristlets, mechanical lifting devices, ladders, ground - fault circuit interrupt devices, lighting equipment, tools, communication devices.

APPENDIX A: POSTING EXAMPLES

 Posting Example

APPENDIX B: PERMIT-REQUIRED CONFINED SPACE (PRCS) OPERATIONS (EPA ORDER 1450.4, 10/6/93)

1. PURPOSE. This order establishes the requirements for the protection of employees operating in confined spaces and prescribes the basic policy, responsibilities, authority and general operational instructions for this program component of the Safety, Health & Environmental Management Program (SHEMP).

2. BACKGROUND. The Occupational Safety and Health Administration, U.S. Department of Labor (OSHA) issued a final rule on Permit-Required Confined Spaces for General Industry on January 14, 1993, having an effective date of April 15, 1993, requiring all Federal agencies to establish a permit-required confined space program, an entry permit system and to establish emergency procedures, engineering and procedural controls to protect all employees performing work activities within confined spaces. OSHA's intention was to reduce exposure, and consequently, resulting death and injury to employees. Approximately 54 fatalities and 11,000 injuries occur each year because of inadequate preparation and control of confined space operations.

   Because of the nature of the Agency's field activities, EPA employees have the potential for exposure to the hazards associated with confined space activities. It is essential that established procedures exist to assure that employee assignments are free from any hazardous exposure and which promote safe, efficient, and productive performance of those assignments.

3. POLICY. It is the policy of the Agency to:

   a. Establish and enforce Agency-wide confined space operational procedures that protect employees from exposure to the hazards associated with confined space entry.

   b. Prohibit assignment of employees to perform work activities within confined spaces (as defined hereinbelow) unless such activities are an essential part of the Agency operation being conducted; and then only if an entry permit has been issued and Agency guidelines for training, hazard identification, safe entry, and rescue have been completed. [NOTE: refer to emergency response and hazardous waste exception at section d(2) hereinbelow]

4. AUTHORITY.

   a. Occupational Safety and Health Act of 1970, Section 6 (29 U.S.C. 655) and Section 19 (29 U.S.C. 668).

   b. Executive Order 12196, Occupational Safety and Health for Federal Employees, 1980.

c. Title 29, Code of Federal Regulations, Part 1910.146 "Permit-Required Confined Spaces for General Industry."

d. EPA Delegations Manual 1200, Delegations 1-3, Occupational Health and Safety.

5. DEFINITIONS.

a. ACCEPTABLE ENTRY CONDITIONS. The conditions that must exist in a PRCS to allow entry and to insure that employees can safely enter into and perform work within the space.

b. ATTENDANT. The individual(s) listed on the entry permit as being stationed outside one or more confined spaces to monitor the authorized entrant's activities and who performs all duties assigned to the attendant in the PRCS operation.

Attendants are knowledgeable individuals that have received training and (1) are aware of the hazards likely to be encountered by entrants, (2) are able to recognize signs/symptoms of exposure, (3) maintain count of entrants and prevent unauthorized entry, (4) understand the communication, warning and exit procedures established for the space to be entered, and (5) summon rescuers when required.

c. AUTHORIZED ENTRANTS. Those individuals listed on the entry permit as being authorized by the entry supervisor to enter the confined space.

Authorized entrants are knowledgeable individuals that have received training and (1) are aware of the hazards likely to be encountered, (2) are able to recognize signs/symptoms of exposure, (3) are able (and certified where required) to use needed protective equipment, and (4) understand the communication, warning and exit procedures established for the space to be entered.

d. CONFINED SPACE. A confined space is any space which: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits); and (3) is not designed for continuous employee occupancy.

e. CONFINED SPACE ENTRY PERMIT. A document containing the following: (1) a brief description of the space; (2) the purpose for which entry is required; (3) the date and duration of the permit; (4) a list of authorized entrants; (5) names of the entry attendants and entry supervisor; (6) a list of known hazards in the permit space; (7) a list of measures to be taken to isolate the space and control/eliminate known hazards; (8) acceptable conditions for entry; (9) any testing results (including name of person performing testing); (10) the rescue guidelines and source of emergency services (including means to summon); (11) communication procedures between entrants and attendants; (12) required protective equipment;

(13) any other necessary information for entry; and (14) any other permits required before entry (e.g.; hot work).

f. 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.

g. ENTRY. The action by which a person passes through an opening into a PRCS. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

h. ENTRY SUPERVISOR. The person (such as employer, foreman, crew chief, etc.) responsible for: (1) determining if acceptable entry conditions are present at a PRCS where entry is planned, (2) authorizing entry, (3) overseeing entry operations, and (4) terminating entry as required by this order and 29 CFR Part 1910.146.

i. HAZARDOUS ATMOSPHERE. A hazardous atmosphere is an atmosphere that exposes employees to a risk of death, incapacitation, injury, or acute illness from the presence of one or more of the following causes: (1) oxygen concentration below 19.5% or above 23.5%; (2) flammable gas, vapor or mist concentrations above 10% of its lower flammable or explosive limit (LFL or LEL); (3) toxic substance concentrations exceeding the OSHA permissible exposure limit (PEL) or ACGIH threshold limit value (TLV) or NIOSH recommended exposure limit (REL); (4) combustible dust concentrations that obscures vision at a distance of five feet or less; and (5) any condition recognized as immediately dangerous to life or health (IDLH).

j. HOT WORK. Operations or activities capable of providing a source of ignition (welding, cutting, burning, heating, riveting, etc.)

k. IMMEDIATE DANGER TO LIFE OR HEALTH (IDLH). The term for 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 PRCS.

l. ISOLATION. The process by which a PRCS is removed from service and completely protected against the release of energy and material into the space by such means as: (1) blanking, blinding, mis-aligning or removing sections of pipe or ducts; (2) double-block and bleed systems; (3) lockout or tagout of all sources of energy; or (4) blocking or disconnecting all mechanical linkages.

m. PERMIT REQUIRED CONFINED SPACE (PRCS). A PRCS is a confined space (see definition) that presents or has the potential for presenting one or more

of the following additional hazards: (a) contains or has known potential to contain a hazardous atmosphere; (b) contains a material with the potential for engulfment; (c) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or a floor which slopes downward and may taper to a smaller cross-section; or (d) contains any other recognized serious safety or health hazard (e.g., electrical hazards, potential flooding).

n. PROHIBITED CONDITION. Any condition identified on the entry permit whose existence in or near the confined space is listed as being unacceptable during entry operations. No entry can be allowed if prohibited conditions exist.

o. RETRIEVAL SYSTEMS. The equipment used for non-entry rescue of entrants from a PRCS upon the occurrence of an emergency. Such systems may include retrieval lines, chest or full body harnesses, wristlets, lifting devices, anchors, or other similar equipment for extricating an employee from the space without entering the space.

6. RESPONSIBILITIES.

a. DIRECTOR, SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT DIVISION - The Director, SHEMD, shall:

(1) Establish EPA PRCS policy and procedures as a component program under the EPA Safety, Health & Environmental Management Program (SHEMP).

(2) Advise the AA-OARM and Agency management officials in planning, development and implementation of the PRCS policies, programs and standard operating practices.

(3) Provide guidance and technical assistance to SHEMPMGRs as needed to assure effective implementation of PRCS policy.

b. REGIONAL OR PROGRAM DESIGNATED SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT OFFICIALS - The RDSHEMOs and PDSHEMOs, shall:

(1) Ensure that all managers and supervisors under their direction are aware of the hazards associated with PRCS operations and that they receive training on identification, evaluation, permitting, employee training, rescue and emergency procedures associated with such confined spaces.

(2) Provide the necessary qualified subordinate staffing, resources and management support to implement and effectively manage PRCS operations.

c. SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT PROGRAM MANAGERS - SHEMPMGRs shall:

(1) Provide direct assistance to their RDSHEMO or PDSHEMO, senior management officials and supervisors in the development, management, implementation, and evaluation of the SHEMP Permit-Required Confined Space Program Component within their areas of responsibility.

(2) Assist supervisors in assuring that all employees receive required training and other technical assistance necessary to comply with this order and 29 CFR Part 1910.146.

(3) Maintain records of all entry permits issued and supporting testing, monitoring and calibration information for a period of one year.

d. ENTRY SUPERVISORS (Project Manager, On-Scene Coordinator, Remedial ProgramManager, etc.) - Shall:

(1) Ensure that employees identified as authorized entrants and attendants are fully qualified to safely enter, work in, and perform rescue in confined spaces, are provided with and required to properly use the necessary safety equipment, and have been instructed to follow all of the provisions of this order and 29 CFR Part 1910.146. Employees not so designated and trained are to be prohibited from any entry into a PRCS. The Entry Supervisor is to ensure that all on-site employees are aware of this prohibition on entry (even for rescue purposes) and provide all employees with information on how to identify, report and respond to emergency situations involving PRCS.

(2) Evaluate all work environments within his/her area of responsibility and identify those work environments to be classified as a PRCS. Prohibit all work within such work environments without first preparing an entry permit and reviewing said permit and the requirements contained therein, with authorized entrants and attendants.

NOTE: Entry Supervisors assigning employees to perform work at non-EPA facilities that may involve entry into a confined space, PRIOR TO ENTRY, where possible, should contact the individual responsible for safety, health and environmental management for such facility and obtain all available information regarding the testing and evaluation of the space to be entered. While the information provided should be reviewed and may prove helpful to the Entry Supervisor, the information should not relied upon as a substitute for full EPA evaluation of conditions for any PRCS entry.

In special and very limited circumstance of an emergency situation requiring immediate action or the removal of hazardous wastes where information about the previous site operations are unknown, such as are frequently encountered by the OSWER-Emergency Response Team, a exception to the no entry without permit prohibition is granted. In such situations, the EPA Entry

Supervisor shall perform testing and evaluation designed to detect all hazards that may be reasonably suspected to exist in such spaces and prepare an entry permit for his/her employees if he/she believes that adequate protection for known hazards can be provided or that failure to enter would immediately endanger the lives of others. Such circumstances are exceptions and must be carefully monitored, with emphasis placed on assuring that employees are fully informed and that emergency response and rescue are readily available. NOTE: This is very limited exception involving extreme life-threatening situations.

(3) Ensure that entry permits contain the requisite information; and that procedures, practices and equipment for safe entry are used at all times.

(4) Monitor PRCS work assignments in progress and terminate any such work when conditions are unacceptable (in variance with the entry permit) or the work is concluded.

(5) Forward the originals of all entry permits issued and all supporting testing, monitoring and calibration data to the SHEMPMGR for recordkeeping.

e. EMPLOYEES - Shall:

(1) Comply fully with all requirements of this order and Title 29 CFR Part 1910.146 in the safe performance of their assigned tasks.

(2) Perform all assigned entries into a PRCS in accordance with the conditions, equipment requirements, and procedural guidelines appearing on the entry permit. Employees are <u>not</u> to enter a PRCS without reviewing the entry permit and following all requirements therein.

(3) Report any observed confined spaces within the work environment that appear to require permitting for safe entry and/or any unsafe, unhealthful conditions or acts to their supervisor for corrective action.

7. <u>REQUIREMENTS AND SAFE OPERATING PROCEDURES</u>

a. All confined spaces are considered PRCS and an IDLH until determined to be otherwise.

b. The entry permit (Attachment A) is the authorizing document permitting an employee to enter a confined space based upon the Entry Supervisor's (Project Manager, On-Scene Coordinator, Remedial Program Manager, etc.) instructions regarding entry preparation, hazard identification atmospheric testing, personal protective equipment (PPE), safety devices, safe operating procedures, and emergency procedures. **It shall be completed, signed by the EPA Entry Supervisor, and posted (e.g., placing signs, placards in a conspicuous place)**

and reviewed with designated entrants, attendants and rescue personnel before entry into any PRCS. No entry into a PRCS is allowed without a properly completed entry permit.

The posted copy must be removed after the job has been completed. The original copy of the permit must be returned to the Health and Safety Office and retained for one year.

EPA entry permits shall not be issued to cover host company, contractor or other non-EPA employees, with the possible exceptions of (1) other Federal employees, provided that sufficient evidence of required training is available; and (2) Senior Environmental Employees (SEE) and similar special employee groups when working in mixed EPA/SEE teams and where the EPA employee serves as team leader, makes all permitting decisions, and controls the activity.

When participating in EPA activities or performing work for EPA involving permit-required confined space entry, all host company employees, contractor employees or others must be issued permits by their own employers and will not be included on EPA permits, be part of an EPA entry team, nor are they to be directly supervised during the confined space entry activity by any EPA employee.

c. Prior to entry into any permit-required confined space, EPA employees will contact their Entry Supervisor to obtain a valid permit.

d. At non-EPA facilities, neither the EPA Entry Supervisor nor any other employee shall sign off on any host company or contractor document or permit relating to any PRCS.

e. All confined spaces will be identified by a sign, placard, or other equally effective means.

f. Isolation or lockout/tagout procedures (29 CFR 1910.147) shall be implemented, which may include physical, mechanical, hydraulic, electrical, pneumatic, or other means.

g. Confined spaces that have been identified as requiring a permit will be guarded against unauthorized entry and positive lockout procedures will be ensured when entering. Positive lockout will include, but is not limited to, mechanical (prevent mechanical movement, such as rotating gears, mixing blades, shaft rotation, etc.); hydraulic (pressurized fluid lines leading to space are positively locked out or bled to prevent accidental energy release); electrical (power to space is positively controlled not to present a hazard); and pneumatic (air lines controlling rotating parts connected to the space are bled, locked, or controlled by other means so as not to create a hazard).

h. The Entry Supervisor shall hold a pre-entry safety briefing with authorized entrants, attendants, and rescue team members to ensure that they understand the hazards, what their responsibilities are, what safety equipment must be used, and what to do in an emergency situation.

i. No entry will be allowed by EPA personnel into a PRCS space without assuring adequate training. Examples of the content of this training include: (1) duties of authorized entrants (e.g., hazard recognition, communication, protective equipment, self-rescue); (2) duties of attendant; and (3) duties of individual authorizing or in charge of entry and rescue team.

j. At least one authorized attendant shall be stationed just outside the access opening while the space is occupied. Also, arrangements must be made to assure that rescue personnel will be readily available to respond to an emergency situation.

   The attendant shall: (1) maintain continuous awareness of the activities and well-being of the person(s) in the confined space through visual and/or voice contact; (2) be trained, qualified, capable, equipped and ready to summon emergency assistance and to assist in emergency rescue; (3) not enter the confined space or leave the area until another qualified person is on duty; (4) continuously maintain an accurate count of all persons in the space; and (5) know of, recognize and monitor for potential space hazards, inside and outside of the confined space.

   The entrant shall maintain contact with the attendant; notify the attendant when initiating an evacuation; and exit the space when ordered to do so, an alarm sounds, or danger is perceived.

k. All personal protective equipment (PPE) must be approved for the hazards associated with the space to be entered. Entry Supervisors should contact their supervisor and/or the SHEMPMGR for guidance on approved equipment.

l. PPE varies with the work to be performed and the type of atmosphere present. The minimum PPE for PRCS entry will include, but is not limited to: (1) approved safety glasses [ANSI Z-87.1]; (2) approved steel toed-shoes

   [ANSI Z-41]; (3) approved hard hat [ANSI Z-89.1]; and (4) approved flashlight [FM-UL Class I, Div. 1, Group A, B, C, D].

   Refer to 29 CFR 1910.146 for details regarding emergency rescue equipment and other safety equipment (e.g., fire extinguisher, portable eyewash, etc.).

m. Atmospheric testing shall be conducted prior to PRCS entry by a trained, qualified person using state-of-the-art instrumentation. Employees entering a PRCS will have a portable atmospheric and monitoring equipment (e.g., oxygen meter, combustible gas meter, organic vapor analyzer, etc.) calibrated prior to entering, and test for: (1) oxygen content by percent volume; (2) flammables and

combustibles reading percent LEL (lower explosive limit); and (3) toxics - carbon monoxide, hydrogen sulfide, chlorine, chlorinated solvents, phosgene, etc. (whichever may be present and appropriate). Readings should be taken at several levels of elevation.

n. With the exception of circumstances listed in Section 6 d (2) hereinabove, EPA **employees are not to be permitted to enter an IDLH confined space atmosphere**. Circumstances should be rare for employees to enter any type of confined space areas.

o. Do not enter radioactive areas without consulting with the Regional/Program Radiation Program official and following EPA's radiation policy.

p. All entries will cease and all EPA personnel will immediately leave the confined space should a non-permitted condition occur. This would include alarm signal(s) or other warnings such as employee symptoms of overexposure or sudden leaks of liquid or gas. An alarm would be a warning of an unsafe condition such as an audible warning indicating an oxygen deficient atmosphere (less than 19.5% (O_2); or a potential flammable hazard (greater than 10% LEL); or toxic gas alarm greater that 35 parts per million (ppm) Carbon Monoxide (CO) or 10 ppm Hydrogen Sulfide (H_2S) or any other means of warning EPA personnel of a non-permitted condition. (Other examples may be a signal line, siren, etc.)

q. A PRCS must be made as clean and free as possible of any hazardous materials prior to entry. The space may be pumped out, flushed, purged, steam cleaned, vacuumed, chemically neutralized or ventilated, but the methods and materials must be compatible with the contents. Review material safety data sheets (MSDSs).

r. Positive mechanical ventilation may be used in conjunction with continuous atmospheric monitoring and with emergency rescue precautions taken in PRCSs with hazardous or potentially hazardous atmospheres **if wearing a self-contained breathing apparatus (SCBA) is unsafe or impractical.** The ventilation equipment must be approved for the conditions and be capable of adequately ventilating the space. The ventilation air source must remain uncontaminated at all times.

s. Covers, lids, doors, and other objects must be removed or secured to prevent closing or falling into the space and to avoid obstructing the opening. Provide pedestrian, vehicle, or other barriers to protect entrants and others from hazards.

t. Hotwork (e.g., welding) in PRCSs must meet OSHA requirements per 29 CFR 1910.252(c)(4), including providing forced local exhaust ventilation and continuous air monitoring. Gas supply bottles must not be placed in the space at any time. When such operations cease for a period of thirty minutes or more, gas lines must be removed or disconnected outside the PRCS.

u. All contaminated equipment and items removed from PRCSs should be handled following acceptable decontamination and disposal procedures.

v. Respirator users will be fit-tested and trained on the devices they will use during PRCS activities and during emergencies.

w. Rescue provisions will be ensured by the permit issuer prior to PRCS entry. Pre-entry contacts must be made to determine availability and capability, if relying upon non-EPA sources.

x. Appropriate measures to prevent unauthorized entry shall be implemented, such as, but not limited to, posting a guard, barricading, or any physical, mechanical, or other means. The confined space shall not be left open unattended unless provisions have been made for preventing unauthorized access. Signs shall be posted near the permit space stating the hazards which may be present and shall include, but not limited to, the following information:

DANGER
CONFINED SPACE
PERMIT REQUIRED
AUTHORIZED ENTRANTS ONLY

8. ATMOSPHERIC TESTING AND MONITORING

Atmospheric testing shall be conducted prior to PRCS entry by a trained, qualified person using state-of-the-art instrumentation. The instrument must be properly calibrated per the manufacturer's recommendations.

a. Hazardous Atmospheres

Known or suspected hazardous atmospheres will be tested first for oxygen deficiency (below 19.5%) or enrichment (above 23.5%); then flammable/explosive levels (above 10% LFL or LEL), then toxics (above PEL, TLV or REL). (Carbon monoxide (PEL = 35 ppm) and hydrogen sulfide (PEL = 10 ppm) are the most commonly monitored toxics); and last, for heat stress. No one shall enter or remain in a PRCS if a hazardous atmosphere exists or instrument alarms sound.

At a minimum, oxygen levels shall be continuously monitored when in the confined space if a SCBA is not worn. The Entry Supervisor shall determine if continuous or periodic monitoring at appropriate intervals for other atmospheric contaminants will be conducted to ensure that acceptable conditions are present.

b. Instruments

Instruments must first be checked for a proper zero indication for combustible and toxic gases and 20.9% oxygen indication in fresh air. Measurements shall be taken through a pick-hole, or with cover slightly opened on the down-wind side of the space at enough locations (minimum top, middle, and bottom) in the confined space so as to be representative of the atmosphere within the PRCS.

c. Records

All testing, monitoring, and calibration records must be forwarded with the entry permit to the SHEMPMGR where they will be maintained for one year.

9. EMERGENCY RESCUE

Emergency situations require immediate action. Plan ahead for how to respond to an emergency and have all the necessary rescue equipment readily available to respond. Response is directed toward getting an entrant out of the confined space, which may require entry into the PRCS. However, rescue should be done from outside of the space whenever possible. NOTE: emergency rescue shall be performed by a team comprised of non-EPA employees, unless the EPA employees are specifically trained in emergency rescue techniques. Under no circumstances should the attendant enter the space to attempt a rescue alone and without having summoned additional assistance. The rescue team may initiate the rescue, but outside help should also be summoned. Emergency response action plans shall be in accordance with 29 CFR 1910.38.

a. The Rescue Team

This team will be composed of qualified, properly trained individuals that have been fully informed of the work activities and hazards of the permitted space. They will be readily available and equipped at all times to begin immediate rescue actions. The team must practice making permit space rescues at least once every twelve months and at least one member must be certified in basic first aid and cardio-pulmonary resuscitation (CPR) skills. If an outside rescue team is summoned, they must be informed of the hazards prior to entering the space for rescue.

b. Minimum Rescue Procedures

Rescue procedures should be able to be set in motion immediately upon the occurrence of an emergency. The procedure should assure a fast response time and include the following steps: (1) Notify the emergency rescue team; (2) Summon outside aid; (3) Observe the entrant(s) until help arrives; (4) Attempt to identify the cause of emergency, so that the proper response action is taken; (5) Carefully set up rescue equipment and don PPE.

Double-check PPE in order to assure proper and safe usage; (6) Be prepared to save the next entrant from outside the space; (7) Administer first aid and CPR if necessary.

10. TRAINING

Entry Supervisors, authorized entrants, attendants, rescue team members and any other personnel authorizing or in charge of entry shall be trained to work safely in and around the PRCS. This training shall be provided annually and will at a minimum include: (1) authorized entrant duties; (2) attendant duties; (3) individual authorizing or in charge duties; (4) hazard recognition; (5) communications; (6) safety and protective equipment; (7) rescue procedures and practice sessions; (8) use of atmospheric testing and monitoring equipment; (9) safe operating procedures; and (10) isolation or lockout-tagout procedures.

Training records will be kept by the SHEMPMGR for a minimum of one year.

ATTACHMENT A: SAMPLE CONFINED SPACE ENTRY PERMIT

The Entry Supervisor's approval of this permit authorizes entry into the confined space listed below. ***Entry is not authorized until the permit has been completed, signed by the Entry Supervisor, posted, and all components implemented.*** *The posted copy shall be removed after the job has been completed and the original shall be returned to the SHEMPMGR to be kept on file for one year.*

General Information

Project Title: _____ Project Number: _____

Good for this Day or Shift Only: _____ From: _____ AM[ ] PM[ ] To: _____ AM[ ] PM[ ]

Purpose for Entry: _____

Description of Confined Space: _

Contractor Notification: Yes[ ] No[ ] N/A[ ] Permit Conditions[ ] Potential Hazards [ ]

Personnel Information

Authorized Entrants	*Attendants*	*Rescue Team*

1. All personnel trained and medically cleared?
Yes[ ]No[ ]
2. Pre-entry briefing held?
Yes[ ]No[ ]
3. Permit conditions understood?
Yes[ ]No[ ]
4. Confined space standard understood?
Yes[ ]No[ ]
5. All personnel agree that entry is safe? Yes[ ]No[ ]

Pre-Entry Preparation

1. *Anticipated hazards:* ____ *O2 Deficiency* __ *Fire/Explosion*
_____ *Toxics* _____ *Corrosives*
_____ *Noise* _____ *Radiation*
_____ *Physical* _____ *Biological* _____*Dusts* _____*Heat/Cold Stress*
Specify: _____

2. *Confined space isolated/prepared?* *Yes[ ] No[ ]*
**All energy sources locked/tagged out?* *N/A[ ] Yes[ ] No[ ]*
**Unauthorized entry posted & area secured?* *Yes[ ] No[ ]*
**All lines capped/blanked/disconnected?* *N/A[ ] Yes[ ] No[ ]*
**Space cleaned/purged/flushed/drained?* *N/A[ ] Yes[ ] No[ ]*
**Entrapment/engulfment hazards abated?* *N/A[ ] Yes[ ] No[ ]*
**Entry permit conspicuously posted?* *Yes[ ] No[ ]*

3. *Confined space atmosphere pre-tested at opening, middle and bottom?* *Yes[ ] No[ ]*
**Oxygen level above 19.5% and below 23.5%* *Yes[ ] No[ ]*
**Combustible gas level below 10% LEL/LFL?* *Yes[ ] No[ ]*
**Toxic gas levels below PEL/TLV/REL?* *Yes[ ] No[ ]*
**Heat stress levels below WBGT TLV?* *Yes[ ] No[ ]*
**Results, instruments used, name of tester, calibration data, date/time, etc. recorded in log book?* *Yes[ ] No[ ]*

4. *Safety equipment issued/implemented/available?* *Yes[ ] No[ ]*
**Personal protective equipment:* __

**Rescue equipment:* ____

**Other safety equipment:* _

**Atmospheric testing and monitoring equipment:* ___

Special Requirements

1. *Continuous or periodic monitoring required?* *Yes[ ] No[ ]*
Specify: _____

2. *Forced or exhaust ventilation required?* *Yes[ ] No[ ]*

Describe: _____

3. *Any other special hazards and control measures?* *Yes[ ] No[ ]*
Describe: _____

Rescue Plan

1. *Rescue plan has been discussed with all personnel and all elements are in place?* *Yes[ ] No[ ]*

2. *Rescue equipment has been set up properly?* *Yes[ ] No[ ]*

3. *Arrangements have been made with local emergency response authorities? Telephone #* _____ *Yes[ ] No[ ]*

4. *Describe rescue plan:* ___

Permit Authorization

As the individual authorizing entry into the permit-required confined space described hereinabove, I certify that I have verified that all actions and conditions necessary for safe entry have been performed and hereby authorize entry for the stated purpose, time, date, duration and for the named entrants.

Entry Supervisor: _____ *Date:* _____