University of Portland

CONFINED SPACE SAFETY PROGRAM

UNIVERSITY OF PORTLAND

AN OREGON EMPLOYER

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University of Portland

CONFINED SPACE SAFETY PROGRAM

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CONFINED SPACE SAFETY PROGRAM

1.0 INTRODUCTION and POLICY STATEMENT

The University of Portland *Confined Spaces Safety Program* is to help prevent injuries associated with confined spaces entry. University of Portland is dedicated to the protection of its employees from on-the-job-injuries. All employees have the responsibility to work safely on the job by following this and all company policies and procedures.

2.0 PURPOSE

The purpose of this *Confined Spaces Safety Program* is:

- To supplement University of Portland standard safety policies by providing safety standards specifically designed to cover confined spaces entry on the job.
- To ensure that each employee is trained and aware of the safety provisions that are to be in place prior to the start of work in a confined space.

The University of Portland *Confined Spaces Safety Program* is designed to instruct employees to recognize the hazards on the job and to establish the procedures that must be followed in order to prevent injury and comply with applicable codes, standards, and regulations.

Each employee trained in these procedures must strictly obey them. If, in the employee's opinion, following the established procedures may present a hazard, the employee must notify a supervisor of his/her concern.

All confined space safety concerns must be satisfied before beginning or continuing work!

3.0 RESPONSIBILITIES

3.1 EMPLOYEE RESPONSIBILITIES

University of Portland employees must:

- Complete all required safety training including training involving confined spaces
- Understand and follow safe work procedures
- Follow the instructions of the supervisor
- Correct and/or report safety violations and unsafe conditions, report accidents
- Know location and operation of safety and emergency equipment

3.2 SUPERVISORS AND DIRECTOR RESPONSIBILITIES

Supervisors and managers must:

- Schedule specialized training and reinforce training involving confined spaces
- Educate and train employees about hazards and safe work practices involving confined spaces
- Ensure that all defective/unsafe equipment is removed from service
- Address safety issues and evaluate employee participation and performance in the safety program
- Report and investigate accidents

3.3 ADMINISTRATOR (ENVIRONMENTAL HEALTH AND SAFETY OFFICER)

It is the responsibility of the designated **Administrator,** the Environmental Health and Safety Officer, to implement this *Confined Spaces Safety Program*. The University of Portland Administrator identifies existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees.

CONFINED SPACE CHECKLIST FOR ADMINISTRATOR: (To Determine If a Confined Space Exists)

In order for a work area to be defined as a confined space it must meet all three of the following criteria:

1) The space has limited openings for entry and exit.
2) The space is not intended for continuous human occupancy. This means that the space was designed to hold something other than people.
3) The space is large enough for a person to enter and conduct work. If a person cannot fit their body into the space then they cannot become trapped inside.

A permit-required confined space is any space that has any of the following conditions:

a) Contains or has a potential to contain hazardous atmosphere.

b) Contains a material that has the potential for engulfing an entrant.

c) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section.

d) Contains any other recognized serious safety or health hazard.

4.0 WHY OSHA HAS STANDARDS FOR CONFINED SPACES

The Federal Occupational Safety and Health Administration (OSHA) recognizes that confined space accidents are generally complex events frequently involving a variety of factors. Consequently, the standards for confined spaces address both the human and equipment-related issues in protecting workers from hazards. Therefore, University of Portland has implemented the following:

- Where protection is required, appropriate protection systems have been implemented
- Performed proper installation of safety systems
- Supervised employees appropriately
- Developed, implemented, and enforced safe work procedures
- Trained workers in the proper selection, use, and maintenance of confined space safety-related systems.

5.0 WHAT THE CONFINED SPACE STANDARDS COVER

The OSHA Safety and Health Standards for General Industry establish that it is the employer's responsibility to initiate and maintain programs as may be necessary for accident prevention. The standards cover all employees except those inspecting, investigating, or assessing workplace conditions prior to the actual start of work or after all work has been completed.

Additionally, OSHA states that the employer must require employees to use appropriate personal protective equipment. The use of personal protective equipment is required for all operations where there is exposure to hazardous conditions or where there are specific references in the standards indicating the need for such use such as confined spaces.

6.0 REQUIREMENTS OF THE CONFINED SPACE SAFETY PROGRAM

University of Portland Confined Spaces Safety Program requires that:

- Personal protective equipment be provided such as a respirator
- Criteria and practices for this equipment be established
- Training on personal protection equipment be conducted
- Workplace and work activities to identify health and physical hazards must be assessed.
- Employees may not be exposed to hazards until the hazards have been controlled
- Employees may not work in a designated confined space without an authorized work permit.

These requirements also mandate hazard assessment and safety systems.

6.1 GENERAL CONFINED SPACE PROGRAM REQUIREMENTS

29 CFR §1926.21 (b) (6) details the training requirements for employers related to confined or enclosed spaces. University of Portland adheres to these standards.

6.1.1 Hazard assessment

University of Portland designates its Administrator (Environmental Health and Safety Officer) as the *Competent Person* to assess the identifiable hazards associated with confined area work areas, occupations, and tasks for the purpose of eliminating or minimizing these hazards by means of engineering, administrative controls and the use of personal protective equipment. The plan Administrator may engage third party consultants to evaluate confined space areas and determine the hazards and mitigation steps to minimize hazards.

At University of Portland, confined space hazards include the following:

Hazards most often encountered at University of Portland include:

- ❑ Entrapment/ Insufficient maneuverability
- ❑ Airborne materials
- ❑ Light
- ❑ Heat/cold
- ❑ Electrical
- ❑ Poor visibility

At University of Portland, confined space hazards may include the following:

- ❑ Entrapment/ Insufficient maneuverability
- ❑ Engulfment
- ❑ Asphyxiation
- ❑ Chemicals
- ❑ Airborne materials
- ❑ Impact
- ❑ Penetration
- ❑ Compression

- ❑ Light
- ❑ Heat/Cold
- ❑ Electrical
- ❑ Poor visibility

Confined space sources of hazards most often encountered at University of Portland include, but are not limited to:

- ❑ Limited access/work area
- ❑ Moving parts and equipment
- ❑ Rolling and pinching parts and equipment
- ❑ Elevated parts and equipment
- ❑ Sharp objects
- ❑ Electricity
- ❑ Hazardous light sources
- ❑ Chemicals

The site assessment must be documented by identifying the workplace surveyed, naming the person(s) conducting the survey, identifying potential hazards, and recording date(s) of the survey.

The site assessment is documented by identifying the workplace surveyed, naming the person(s) conducting the survey, identifying the potential hazards, and recording the date(s) of the survey. (See Appendix A)

6.1.2 List of confined spaces

"Confined or enclosed space" means any space having a limited means of egress that is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. A confined space must have the following to be considered a confined space:

- It is large enough and so configured that an employee can fully enter the space and perform work
- It has limited or restricted means for entry, exit, or both
- It is not designed for continuous human occupancy.

University of Portland has confined spaces in many different buildings on campus. The inventory is currently linked on the Pilots UP Physical Plant page, under the "Safety Information" Confined Space Program Subtab.

The inventory is update as confined spaces are identified on campus. To request a copy of the inventory please email Environmental Health & Safety at ehs@up.edu

6.1.3 Engineering and administrative controls

University of Portland uses all feasible engineering and administrative controls to mitigate or minimize injury and illness from exposure to hazards. Where hazards still exist after application of these controls, personal protection equipment is mandated.

Work Permits: The hazards identified involving the work that is to be accomplished must be communicated to those doing the work, but also to other personnel whose actions could affect the safety of the process.

University of Portland work authorization permitting protocol outlines the steps the shop supervisor or contractor representative needs to follow to obtain the necessary clearance to get a confined space job started. The work permit protocol specifies the required precautions and procedures that must be adhered to when working in a University of Portland confined space and after the work has been completed (see Appendix A):

1) Lockout/tagout procedures
2) Line breaking procedures
3) Confined space entry procedures
4) The permit system itself including hot work authorizations
5) Testing and air monitoring provisions
6) Employee training
7) Control methods
8) Designation of persons authorized to permit entry
9) Authorized entrants, attendants, and air monitors.

6.1.4 Provision for protective equipment

EHS has determined the personal protective equipment required based on the simultaneous exposures to all hazards. Adequate protection against the highest level of each of the identified hazards is subsequently provided. If necessary, new or additional equipment is selected which ensures the level of protection needed.

At University of Portland, the primary confined space related hazards to employees are:

- ❑ Limited access
- ❑ Entrapment/insufficient maneuverability
- ❑ Airborne materials
- ❑ Heat/cold
- ❑ Electrical
- ❑ Poor visibility

University of Portland provides all mandated personal protective equipment (PPE) including the cleaning and disposal of protective equipment as well as repair, maintenance and replacement of protective equipment as needed to maintain effectiveness of protection.

Required PPE and other confined space safety requirements may include:

- ❑ Eye protection
- ❑ Attendant monitoring as required

- ❑ Gloves
- ❑ Respiratory protection (dust/particulate mask or respirator as needed)
- ❑ Hearing protection as needed

6.1.5 Signs for designated confined space areas and hazardous areas

Hazard warning signs restricting unauthorized employees against entering the confined space are posted at the entrance to University of Portland confined spaces (except for confined spaces where are entered via the ground such as manholes and trap doors). Signs are available from the EHS Officer or on the Pilots UP Page.

6.1.6 Personal protection requirements and training

Employees may be exposed to hazards by performing a specific task. Employees wear the appropriate PPE for each task and any hazards that may occur.

Employees are trained on recognizing these hazards and are trained in the use of protective equipment including:

1. **Confined Space Permits and Electrical/Hazardous Energy Control**: all personnel accessing any confined space at University of Portland must be trained and certified in

   (a) obtaining the necessary confined space access permits (including hot work permits)

   (b) hazardous energy lockout/tagout safety procedures.

2. **Entrapment:** all personnel accessing any confined space at University of Portland must be wearing all required PPE including gloves, boots, hard hat, dust mask, goggles, and may not be wearing excessively loose clothing, jewelry or other items that is more likely to become entangled in machinery.
3. **Airborne Materials:** all University of Portland employees entering a confined space which may have airborne materials must wear a

Engagement in Toxic Atmospheres:

University of Portland employees do not engage in Confined Space activities when a toxic atmosphere. If there is any reason to believe that there is a toxic breathing environment, the confined space should be monitored to determine if the possibility for one exists. Examples of a toxic atmosphere would include toxic (poisonous) air, or an explosive atmosphere.

6.1.7 Safety monitoring systems

When no other alternative protection is available, University of Portland implements a safety monitoring system using a spotter in its confined space area. If and when this condition should ever exist, only an individual qualified by University of Portland Administrator (EHS) ***personally*** monitors the safety of workers. While performing this task the spotter:

- Is competent in the recognition of identifiable hazards
- Is capable of warning workers of the hazards
- Is operating on the same walking/working surfaces as the workers and is within eyesight of them
- Is close enough to work operations to communicate orally with workers
- Has no other duties to distract him/her from the monitoring function

6.1.8 Discipline

Anyone refusing or repeatedly failing to use the required equipment and/or follow procedural requirements for University of Portland confined space will be removed from the associated work assignments and areas and appropriately disciplined. The employee's supervisor and Human Resources will be made aware of the failures to follow procedural requirements.

6.1.9 PPE Design Standards and Maintenance

Personal protective equipment conforms to NIOSH, ANSI and/or MSHA standards and is of safe design and construction for the work task.

Personal protective equipment used is inspected each day of use and is maintained in serviceable condition. Prior to being reissued to another employee, items of personal issue are cleaned, sanitized as appropriate, and repaired. Tools and equipment are maintained in safe operating condition. Defective equipment is taken out of service.

6.1.10 Hazardous energy control

Appropriate safety procedures, including lockout/tagout, are used when working on machinery and equipment, and when evaluating equipment safety.

Machinery is not serviced, repaired, or adjusted while in operation. The exception is equipment that is designed or fitted with safeguards to protect the person performing the work. See University of Portland *Lock Out Tag Out Control of Hazardous Energy Program* for complete details.

6.1.11 Accident/injury procedures

Should any injury or illness incident involve the failure of any confined space procedure, device or equipment, any University of Portland supervisor is authorized to immediately restrict all access to the confined space until the Administrator authorizes reentry after a thorough investigation and abatement of hazards. Any accidents, injuries, or near misses should be reported via the University Report of Injury Form.

6.1.12 Specific training

All University of Portland employees required to enter University of Portland confined space must (a) secure an authorized Confined Space work permit (b) always have a spotter monitoring their situation and (c) wear the PPE required. They must also be instructed in the following:

1. The nature of the hazards involved and necessary precautions to be taken
2. The use of protective and emergency equipment required
3. Entry procedures
4. Rescue procedures and equipment
5. The correct procedures for erecting, maintaining, disassembling, and inspecting confined space protection systems
6. The use and operation of safety monitoring systems and the role of each employee in the safety monitoring system when the system is in use
7. The limitations on the use of mechanical equipment during the entry into the confined space
8. The correct procedures for equipment and materials handling and storage
9. Employees' roles in University of Portland Confined Spaces Safety Program
10. The details of the University of Portland Confined Space Safety Program

Additional Confined Spaces Safety Program training details include:

1. University of Portland Administrator, currently the Environmental Health and Safety Officer, conducts all confined spaces training along with a third party consultant.
2. Every employee that engages in confined space work is trained in the Confined Spaces Safety Program on an annual basis
3. *All employees* sign off on required safety training related to confined spaces
4. Any employee who has not received appropriate training in University of Portland Confined Spaces Program is not allowed to participate in confined spaces work until he/she has completed the training

Trainer: The University of Portland Administrator (EHS Officer) prepares a written certification that identifies each employee trained and the date of the training. The Administrator or actual trainer signs the certification record.

See Appendix H for detailed confined space assessment and entry information.

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APPENDIX A

UNIVERSITY OF PORTLAND CONFINED SPACE SITE ASSESSMENT FORM
Person(s) conducting this assessment:
Date of assessment:
Name of the confined space:
Confined space hazards identified:
1.
2.
3.
Personal Protective Equipment Required:
a.
b.
c.
Specific Tasks Performed in this Confined Space that may be hazardous:
1.
2.
3.
Authorized Work Permit obtained in advance? Yes No *(if no, work may <u>not</u> begin)*
❑ Lockout/tagout procedures:
❑ Line breaking procedures:
❑ Confined space entry procedures:
❑ Hot work authorizations:
❑ Testing and air monitoring provisions:
❑ Employee training:
❑ Control methods:
❑ Designation of persons authorized to permit entry:
❑ Names and signatures of authorized entrants, attendants, and air monitors:
• Entrants:
• Attendants:
• Air Monitors:

University of Portland

APPENDIX B

CONFINED SPACE HAZARDS

Toxic contaminants.

Exposure limits are the concentrations of a chemical substance to which employees can be exposed without exhibiting adverse health effects. They take into consideration the toxicity of the chemical substance under both acute and chronic exposure conditions and the possible routes of exposure. Both local and systemic health effects are reviewed in assessing a substance's toxicity.

Threshold Limit Values (TLVs).

Exposure of employees to inhalation, ingestion, skin absorption, or contact with any material or substance at a concentration above those specified in the "Threshold Limit Values of Airborne Contaminants for 1970" of the American Conference of Governmental Industrial Hygienists will be avoided.

The American Conference of Governmental Industrial Hygienists (ACGIH) sets *Threshold Limit Values (TLVs)*, which are 8-hour TWAs (Time Weighted Average) designed to protect nearly all workers from adverse health effects.

Threshold Limit Values (TLVs) may be obtained from Material Safety Data Sheets or from publications by ACGIH. If atmospheres with contaminants in concentrations greater than their TLVs must be entered for work, appropriate personal protective equipment must be worn.

Other exposure limits.

Other common exposure limits and their definitions are as follows:

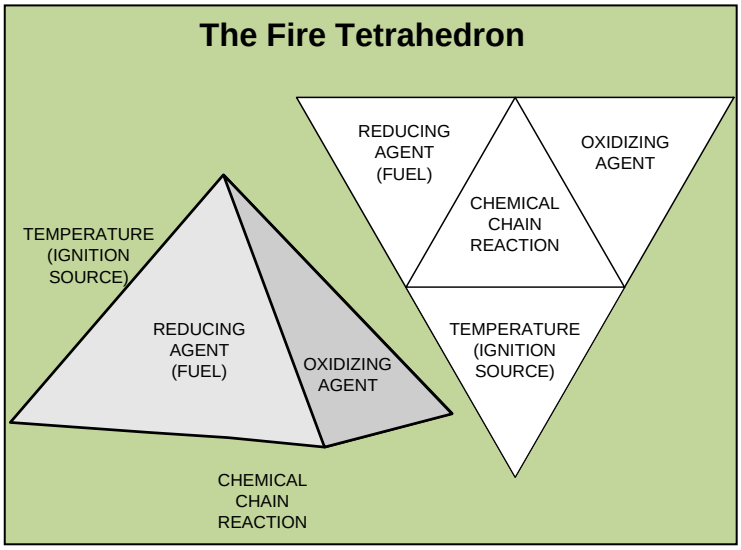
Short-Term Exposure Limits (STELs)

The Short-Term Exposure Limits (STELs) are 15-minute time-weighted averages to be used for short-term task exposures. Workers can be exposed at STEL concentration for 15-minutes up to four times/day. Exposure periods may not occur within the same hour.

Immediately Dangerous to Life or Health (IDLH).

The National Institute for Occupational Safety and Health (NIOSH) has developed concentrations considered to be Immediately Dangerous to Life or Health (IDLH). The IDLH is the airborne concentration above which the average person would experience adverse, irreversible health effects if the exposure is for more than 30 minutes.

For atmospheres containing contaminants in concentrations above their IDLH, respiratory protection of supplied air must be worn.



Flammable contaminants.

Hazards of Flammable Contaminants

The primary hazard with flammable and combustible contaminants is fire or explosion. The fire tetrahedron depicts the required elements for a fire:

- Fuel – the solvent or other flammable material;
- A source of oxygen or oxidizing agent – typically air or chemical oxidizers such as hydrogen peroxide;
- An ignition source – heat, flame, spark, or friction; and
- A chemical chain reaction to sustain combustion.

Each flammable and combustible material has a specific flammable and explosive range. The broader this range, the more susceptible a flammable material is to igniting or exploding.

Flammable/Explosive Ranges in Air

Chemicals are considered flammable or explosive in air concentrations greater than the Lower Explosive Limit (LEL) but less than the Upper Explosive Limit (UEL). The range between the LEL and UEL is referred to as the Flammable Range.

- LEL = Lower Explosive Limit – the minimum concentration of a chemical in air necessary to support combustion. Below the LEL the concentration is too lean to burn, meaning that there is insufficient fuel and excess oxygen.
- UEL = Upper Explosive Limit – the maximum concentration of a chemical that will support combustion. Above the UEL the material is too rich to burn because there is too much fuel present and insufficient oxygen.

Flammable gases are classified based on their flammable range. Gases with LELs less than or equal to 13%, regardless of the UEL, are classified as flammable. In addition, gases with a flammable range of at least 12% are also classified as flammable.

Lower Explosive Limits Table

LOWER EXPLOSIVE LIMIT OF SOME COMMONLY USED SOLVENTS

SOLVENT	LOWER EXPLOSIVE LIMIT IN PERCENT BY VOLUME OF AIR AT 70°F (21.11°C)
Acetone	2.6
Amyl Acetate (iso)	(1) 1.0
Amyl Alcohol (n)	1.2
Amyl Alcohol (iso)	1.2
Benzene	(1) 1.4
Butyl Acetate (n)	1.7
Butyl Alcohol (n)	1.4
Butyl Cellosolve	1.1
Cellosolve	1.8
Cellosolve Acetate	1.7
Cyclohexnone	(1) 1.1
1,1 Dichloroethylene	5.9
1,2 Dichloroethylene	9.7
Ethyl Acetate	2.5
Ethyl Alcohol	4.3
Ethyl Lactate	(1) 1.5
Methyl Acetate	3.1
Methyl Alcohol	7.3
Methyl Cellosolve	2.5
Methyl Ethyl Ketone	1.8
Methyl n-Propyl Ketone	1.5
Naphtha (VM&P) (76°. Naphtha)	0.9
Naphtha (100° Flash) Safety Solvent – Stoddard Solvent	1.0
Propyl Acetate (n)	2.8
Propyl Acetate (iso)	1.1
Propyl Alcohol (n)	2.1
Propyl Alcohol (iso)	2.0
Toluene	1.4
Turpentine	0.8
Xylene (o)	1.0

Footnote (1) At 212°F (100°C).

Oxygen deficient atmosphere.

Oxygen deficient atmospheres are those atmospheres where there is less than 19.5% oxygen.

Oxygen deficient atmospheres pose a significant threat to health and safety and may not be entered unless wearing appropriate respiratory protection.

Additional hazards.

Additional hazards can also exist. As noted above, hazards can include but are not limited to entrapment, engulfment, insufficient maneuverability, chemicals, airborne materials, impact, penetration, compression, hazardous light, heat, cold, electrical, and poor visibility.

APPENDIX C

NECESSARY PRECAUTIONS FOR ENTERING CONFINED SPACES

Engineering controls must first be implemented whenever feasible. Engineering controls include ventilation. When such controls are not feasible to achieve full compliance, protective equipment or protective measures will be used to keep the exposure of employees to air contaminants within the limits prescribed.

Any equipment and technical measures used for this purpose must first be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use will comply with requirements for respiratory protection.

(NOTE: No respirators are currently required or permitted at University of Portland.)

Exposure monitoring

Exposure monitoring will be conducted when hazardous materials or physical agents present in the workplace that generate exposure risk to employees, contractors, or visitors. Exposure monitoring is required when employees wear respiratory protection. Employee exposure monitoring will be conducted under the direction of an industrial hygienist. In enclosed or confined areas in which hot tar, asphalt, enamel, or similar materials are being heated or applied, the operation will conform fully to exposure determination and exposure monitoring.

Ventilation

When sufficient ventilation cannot be maintained without blocking the means of access, employees in the confined space will be protected by air line respirators; an employee on the outside of the confined space will be assigned to maintain communication with those working within, and to aid them in an emergency. Either general mechanical or local exhaust ventilation will be provided whenever welding, cutting, or heating is performed in a confined space.

Reducing the flammable/explosion hazard

Actions that can be taken to reduce or minimize the potential for fire/explosion include:

- Isolate flammable liquids from oxidizers and other incompatible materials;
- Remove sources of ignition such as flames, unsafe electronic equipment, etc.;
- Provide or maintain good ventilation to avoid buildup of fuel vapors;
- Use supplemental exhaust during maintenance or other non-routine operations; and
- Know the types and locations of all fire protection suppression equipment.

Liquefied petroleum gas

Liquefied petroleum gas containers and equipment will not be used in unventilated spaces, below grade in pits or trenches, below deck, or in confined areas where dangerous concentrations of gas may accumulate.

Cylinders

Cylinders containing oxygen, acetylene, or fuel gases will not be stored or taken into confined spaces.

Gasoline-driven arc welders

Gasoline-driven arc welders will not be used in confined spaces.

Temporary heaters

When heaters are used in confined spaces, special care will be taken to provide sufficient ventilation to ensure proper combustion, maintain the health and safety of workmen, and limit temperature rise in the area.

Torch valves

For the elimination of possible fire in enclosed spaces as a result of gas escaping through leaking or improperly closed torch valves, the gas supply to the torch will be positively shut-off at some point outside the enclosed space whenever the torch is not to be used or whenever the torch is left unattended for a substantial period of time, such as during the lunch period. Overnight and at the change of shifts, the torch and hose will be removed from the confined space. Open end fuel gas and oxygen hoses will be immediately removed from enclosed spaces when they are disconnected from the torch or other gas-consuming device.

APPENDIX D

PROCEDURES FOR ENTERING CONFINED SPACES AT *UNIVERSITY OF PORTLAND*

WHENEVER ANYONE ENTERS INTO A CONFINED SPACE HE/SHE MUST ALWAYS:

A. ***CHECK FOR TOXIC BREATHING ENVIRONMENT IF THE POSSIBILITY FOR ONE EXISTS***
B. ***HAVE AN ATTENDANT SPOTTER MONITORING THEIR SITUATION***
C. ***WEAR THE PPE REQUIRED***

Refer to the confined space inventory for information on what is required for each confined space on campus. This will include whether the space is a permit required confined space, what hazards may be present, and what PPE is required.

During entry into a confined space, fill out the documentation below:

Confined Space #1 Name: _____

Confined Space #2 Name: _____

Confined Space #3 Name: _____

Appendix D (continued)

Guidelines/Options for Breathing PPE:

Lifelines

Where an employee must enter a confined space through a manhole or other small opening, means will be provided for quickly removing him in case of emergency. When safety belts and lifelines are used for this purpose, they will be attached to the employee's body so that his body cannot be jammed in a small exit opening. An attendant with a pre-planned rescue procedure will be stationed outside to observe the employee at all times and be capable of putting rescue operations into effect.

When working in fast currents, murky water, or in confined spaces, a tether line will be attached to the diver, and it will be continuously tended from the surface.

Supplied air respirators

All employees working in confined areas where high concentrations of toxic substances are present in the atmosphere, but not immediately hazardous to life, will wear supplied air respirators. Supplied air respirators will also be worn by employees engaged in abrasive blasting, welding in confined space, spray painting with lead paints, applying clear resin curing compound, coal-tar enamels or other toxic coatings, or carcinogenic or suspected carcinogenic material unless adequate ventilation is provided and tests verify that toxic materials are maintained within PEL/TLV limits as follows: the more stringent requirement of OSHA PELs, ACGIH TLVs, or more stringent state or local standards, or the industrial hygienist responsible for the work.

Self-contained breathing apparatus

Employees entering or working in unknown atmospheres or atmospheres IDLH (immediately hazardous to life or health), due to toxic concentrations of airborne contaminants or oxygen deficiency, will wear positive pressure self-contained compressed-air breathing apparatus of an approved type. No employee will enter such atmospheres unless accompanied by another adequately protected employee or is wearing a safety line attended by a person wearing the same type of self-contained breathing apparatus. Employees will be instructed and trained in the use of self-contained breathing apparatus prior to exposure to atmospheres hazardous to life.

Supplied air respirators with positive pressure regulators and emergency self-contained escape bottles may be used in lieu of self-contained breathing apparatus.

Self-contained oxygen breathing apparatus

Self-contained oxygen breathing apparatus may be approved for use in rescue operations conducted by a trained rescue crew.

Self-rescuer

Employees and others exposed to underground environments, such as tunnels and shafts, may be provided with an approved self-rescuer device. Employees will have satisfactorily completed an MSHA-approved self-rescue course or equivalent certified training prior to going underground. Visitors instructed in the operation of the self-rescuer and accompanied by a trained employee are exempt from this training.

APPENDIX E

ENTRY PROGRAMS

It is critical that all activities by employees be controlled while they are working on or near confined spaces.

Work Permits (see Appendix G for sample permit illustration)**:** The hazards identified involving the work that is to be accomplished must be communicated to those doing the work, but also to other personnel whose actions could affect the safety of the process. University of Portland work authorization permitting protocol outlines the steps the maintenance supervisor, contractor representative, or other person needs to follow to obtain the necessary clearance to get a confined space job started.

The work authorization protocol specifies the required precautions and procedures that must be adhered to when working in a University of Portland confined space and after the work has been completed:

1. Lockout/tagout procedures
2. Line breaking procedures
3. Confined space entry procedures
4. Hot work authorizations
5. Testing and air monitoring provisions
6. Employee training
7. Control methods
8. The permit system itself
9. Designation of persons authorized to permit entry
10. Authorized entrants, attendants, and air monitors.

APPENDIX F

DEFINITIONS

ANSI means American National Standards Institute.

Approved means, for the purpose of this section, tested and certified by the manufacturer or any recognized national testing laboratory to possess the strength requirements specified in this section.

Authorized Person means a person approved or assigned by University of Portland to perform a specific duty or duties or to be at a specific location or locations at the jobsite.

Administrator means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees and who has the authorization to take prompt corrective measures to eliminate them.

Confined or Enclosed Space means any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere.

Construction Work means work for construction, alteration, and/or repair, including painting and decorating.

Employee means every laborer or mechanic regardless of the contractual relationship between the laborer and mechanic and the contractor or subcontractor who engaged him. *Laborer* generally means one who performs manual labor or who labors at an occupation requiring physical strength; *mechanic* generally means a worker skilled with tools.

MSHA means Mine Safety and Health Administration

NIOSH means National Institute for Occupational Safety and Health.

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APPENDIX G

CONFINED SPACE ENTRY PERMIT

This permit must be completed prior to entry into the confined space.
Entry cannot be performed if any boxes are marked "No." This permit is valid for only 8 hours.

Date of entry: _____ Time of Entry: _____

Location: _____ Type of space: _____

Equipment to be worked on: _____

Work to be performed: _____

Anticipated time needed to complete work: _____

Anticipated Hazards: _____

Entry personnel: _____

Attendants: _____

1. Check for toxic breathing environment if the possibility for one exists.

Atmospheric checks:			Acceptable Conditions
	Oxygen	_____% O_2	19.5 % to 23.5 %
	Explosive	_____% LFL	<10% LEL/LFL
	Toxic	_____ppm	0-35 ppm Carbon Monoxide
			0-10 ppm Hydrogen Sulfide

Atmospheric Tester's Initials: _____ Time: _____ am pm

2. Isolation of pumps/lines:

	N/A	Yes	No
Pumps or lines blocked, blinked, or disconnected?	( )	( )	( )

3. Ventilation:

	N/A	Yes	No
Mechanical	( )	( )	( )
Natural ventilation only	( )	( )	( )

4. Hot work permit required? ( ) ( ) ( )

5. Atmospheric checks *after* isolation and ventilation, if applicable:
   Oxygen: _____% O_2
   Explosive: _____% LEL
   Toxic: _____PPM

6. Communication procedures: _____

7. Lockout procedures, if applicable: _____

8. Entrant(s), attendant(s), and rescue personnel (if applicable) have successfully completed all required training? Yes ( ) No ( )

9. Equipment:

	N/A	Yes	No
Direct reading sampling device which is properly calibrated	( )	( )	( )
Safety harnesses and lifelines for entrants and attendants	( )	( )	( )
Mechanical retrieval/hosting equipment	( )	( )	( )
Communication equipment	( )	( )	( )
SCBA or Type C air line respirator	( )	( )	( )
Personal protective equipment and clothing	( )	( )	( )
Electrical equipment/Lighting/Non sparking Tools	( )	( )	( )
Traffic barriers/entrance covers	( )	( )	( )

I have reviewed the work authorized by this permit and the information pertaining to each item. Safety procedures have been received and are understood by all personnel.

Entry Supervisor *Signature*: _____ **Date:** _____

ALTERNATE ENTRY

Alternate entry is a specific procedure for entering a permit space without a full permit. Alternate entry procedures vary from permit entry procedures in several significant ways. For example: an attendant is not required; rescue procedures are not required; and there are fewer documentation requirements.

Only the following sections of the confined space rule apply:

- Evaluations
- Equipment
- Alternate entry procedures
- Training

1. **First, the following is required:**
   - Eliminate all hazards; OR
   - Eliminate all physical hazards in the space and control all hazardous atmospheres with continuous ventilation

2. **Alternate entry procedures must be developed that address the following:**
   1. Who can authorize alternate entry procedures and is responsible for ensuring safe entry conditions
   2. The hazards associated with the space
   3. The methods used to eliminate the hazards
   4. The methods used to ensure the hazards have been eliminated
   5. The methods used to test the space for all hazardous atmospheres
   6. The methods used to determine if unsafe conditions occur before or during entry
   7. The criteria and conditions used for evacuating the space
   8. The methods for training employees in these procedures
   9. The methods for ensuring employees follow these procedures

Alternate entry procedures do not have to be in writing, but it is useful to do so.

When using ventilation to control atmospheric hazards:

- Use only properly calibrated direct-reading meters to test the atmosphere.
- Test the atmosphere for all identified atmospheric hazards before entering the space.
- Do not allow employees to enter until testing verifies that all identified atmospheric hazards are adequately controlled by the ventilation.
- Perform continuous monitoring for all atmospheric hazards during the entry.
- Immediately evacuate the space:
  - When monitoring indicates the return of atmospheric hazards.
  - Upon any failure with the direct-reading instrument.
  - Upon any failure with the ventilation.
  - When a new hazard is introduced or conditions within the space change.

If a space is evacuated, it cannot be re-entered as an alternate entry unless:

- The conditions that necessitated the evacuation are corrected; and
- The re-entry is treated and documented as a new entry.

3. **Ensure that all employees who enter:**
   - Have the opportunity to observe the activities required to comply with the alternate entry procedures
   - Have an effective means of communication to request help in an emergency

4. **Provide training:**
   - For all new employees.

- Before an employee is assigned permit space duties.
- Before there is a change in an employee's assigned duties.
- When there is a hazard for which the employee hasn't already been trained, or when there is a change in the hazards of an existing confined space.
- When there are changes to the permit program.
- When the permit audit shows deficiencies.
- Whenever there is a deviation from the established procedures or employee knowledge of the procedures is inadequate.

Document the training as follows:

- Contains the employee's name, the name and signature of the trainer, and the date of training.
- Contains the responsibilities for which they were trained.
- Is available for inspection by employees and their authorized representative.

Provide this training:

- For all new affected employees.
- For all employees whose duties change to include work in areas with permit spaces.
- When inadequacies in an employee's knowledge indicate that the employee has not retained the requisite understanding.
- When there is a change in the permit program.
- When there are new or previously unidentified permit spaces.

Ensure all employees understand how to recognize permit spaces in their work area.

5. **Finally, document the entry! There are ten items that must be documented, if they apply:**
   a) The location of the space
   b) The hazards of the space
   c) Measures taken to eliminate the hazards
   d) Measures taken to control the atmospheric hazards
   e) The identity of the direct-reading instruments used to test the atmosphere
   f) The results of the atmospheric testing
   g) The date of entry
   h) The duration of the entry
   i) Any and all conditions that required the evacuation of the space
   j) The name, title, and signature of the person responsible for ensuring the safe entry conditions

Maintain this documentation for the duration of the entry at the location of the entry. The rule does not require the documentation to be kept after the entry is complete, but it would be a best practice to do so in order to evaluate the alternate entry procedures for effectiveness and to make improvements.

See following page for a sample Alternate Entry Form

University of Portland

Use this form to temporarily enter a permit-required confined space using Alternate Entry Procedures (no permit required). Post form at entry site.	**CONFINED SPACE ALTERNATE ENTRY FORM**	*This form is only valid for the duration of work being performed and for no more than 8 hours.*

General

Space to be Entered:		Date **&** Time Issued:	
Location of Space:		Date **&** Time of Expiration:	
Purpose of Entry:		Department **or** Contractor:	
ENTRANT(S):			
ATTENDANT(S):			

Requirements

Confined Space Assessment Criteria for Alternate Entry Procedures	Yes	No
Has the confined space hazard assessment form been reviewed?		
Is the *only* hazard in the space an actual or potential hazardous atmosphere? (specify):		
Have all *serious* hazards within the space been eliminated without entry into the space? (e.g., entrapment, engulfment, exposed steam, exposed electrical, extreme temperatures, mechanical)		
Will continuous forced-air ventilation alone be sufficient to maintain the space safe for entry? (Record pre-entry results below and re-test at least every two hours.)		
Will continuous forced-air ventilation be in use for the duration of work being performed inside the space?		
Will work being done inside or near the space not introduce new *serious* hazards? (e.g., welding, chemicals, exposed steam, exposed electrical, painting fumes)		
Will an attendant be outside the space any time work is being performed inside the space? (Attendant must have the means to communicate with entrant and ability to summon rescue services, e.g., 911, UHF Radio.)		

Atmospheric Testing

Atmospheric Gases *(test in this order)*	**Permissible Limits** *(must be within limits)*	Pre-Entry Time	Time During Entry – Record Readings Every 2 Hours (8-Hour Maximum)				
		AM / PM	AM / PM	AM / PM	AM / PM	AM / PM	AM / PM
Oxygen (O_2)	19.5% to 23.5%	%	%	%	%	%	%
LEL (Lower Explosive Limit)	Under 10%	%	%	%	%	%	%
Carbon Monoxide (CO)	Under 35 ppm	ppm	ppm	ppm	ppm	ppm	ppm
Hydrogen Sulfide (H_2S)	Under 10 ppm	ppm	ppm	ppm	ppm	ppm	ppm
Other: (specify)	(specify)						
	Tester's Initials						

Monitoring Equipment Make and Model	Serial Number	Calibration Date	Bump Test Passed Prior to Use? **(required)**	**Yes**

Final Determination

If all conditions are checked 'YES' in the requirements section, employees may temporarily enter the confined space without a permit.

☐ **Conditions are Safe for Temporary Entry Without a Permit** ☐ **Conditions are Unsafe for Temporary Entry Without a Permit**

Authorization

We have reviewed the work authorized by this form and the information contained here-in. This form is not valid unless all appropriate items are completed. We certify that all actions and conditions necessary for safe entry have been performed.

Risk Management Representative:	(print):	(sign):
Chief **or** Supervisor Authorizing Entry:	(print):	(sign):

Cancellation

Entry will be terminated and this form will be cancelled when: 1) The entry operations covered by this form have been completed; or 2) A condition that is not allowed under this form arises in or near the space. Re-entry into the confined space will not be allowed until all hazards are controlled or eliminated and a new alternate entry form or permit is completed.

Form must cancelled by Entry Supervisor and kept on file by departments for 3 years.

Cancelled by:		Date & Time:	

Reason: ☐ Work Complete ☐ Conditions Violate Form ☐ New Hazards ☐ Other (Specify)

University of Portland

APPENDIX H

DETAILED CONFINED SPACE ASSESSMENT AND ENTRY INFORMATION

CONFINED SPACE CHECKLIST FOR University of Portland ADMINISTRATOR:

(To Determine If a Confined Space Exists)

1. The space is not designed for entry
2. There is a mechanical hazard present
3. There is a health or environmental hazard present:
    a. Oxygen Deficiency?
    b. Methane Gas present?
    c. Welding Fumes or others that could cause Explosion?
    d. There is potential for engulfment (i.e. manholes, snow tunnels, trenches, etc.)

IF ANY OF THE FOUR CONDITIONS EXIST, THAN A PERMIT MUST BE OBTAINED FOR WORK IN THIS CONFINED SPACE. NOTIFY SAFETY COORDINATOR IF THIS CONDITION EXISTS AND OR IF SUBCONTRACTOR IS WORKING WITHOUT A CONFINED SPACE PERMIT.

To test a confined space we utilize the services of an outside agency to examine and determine the quality within a specific space in question, prior to work taking place contact:_____

CONFINED SPACES

1) The confined space is <u>any</u> space that has the following conditions:
    a) Space is large enough and configured that a person can bodily enter and perform assigned work.
    b) Space has limited or restricted means for entry or exit (For example: tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that have limited entry).
    c) Space is not designed for continuous employee occupancy.

    Note: Needs all 3 to be categorized as a confined space.

PERMIT – REQUIRED CONFINED SPACE

2) The permit-required confined space is <u>any</u> space that has the following conditions:
    a) Contains or has a potential to contain hazardous atmosphere.
    b) Contains a material that has the potential for engulfing an entrant.
    c) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section.
    d) Contains any other recognized serious safety or health hazard.

    Note: Needs only 1 to be a permit-required space.

3) The limited openings can be small as in manholes, few as in tanks or boilers, or as large as in open topped spaces such as pits, trenches, and excavations.
4) The atmosphere in a confined space may be extremely hazardous because of the lack of natural ventilation.

    Confined spaces will be tested in this order:
    a) Oxygen-deficient atmosphere
    b) Flammable atmosphere
    c) Toxic atmosphere
5) When University of Portland arranges to have a contractor perform work that requires permit space entry:
    a) Contractor is responsible for i) informing its personnel that the workplace does contain permit spaces and ii) must have a qualified program that meets all requirements.
    b) University of Portland must identify to the contractor all elements and hazards that it has experienced with the space, including any precautions or protection implemented in or surrounding the space.

c) Both parties (University of Portland and contractor) will coordinate work schedules being conducted near space area.

Contractor will be responsible for the following in a space that requires permit entry:

d) Obtain all information from University of Portland before entry.

e) Schedule work with University of Portland to conform to requirements of protecting all personnel near the confined space.

f) Describe its confined space program in detail to University of Portland, and any other pertinent information relating to the confined space work.

6) University of Portland will use the local Fire Department for any rescue or any emergency situation. Contractor's attendant will have phone number of local Fire Department.

CONFINED SPACE KEY ELEMENTS

1) PRE-ENTRY PROCEDURES

a) Work Space History: What has the confined space been used for, or what previous cargo has it contained? This should include not just the last cargo, but several previous cargoes as well.

b) Securing the Work Space: All piping and valves leading to the work space should be closed and blanked. Any machinery in the workspace should be locked out.

c) Space Testing: The confined space should be tested for flammables, toxins, and oxygen-deficient atmospheres which are any atmospheres that have less than 19.5% oxygen. (Oxygen deficiency in confined spaces results in more fatalities than any other hazardous atmosphere.)

d) Ventilation and Illumination: Adequate ventilation and lighting should be supplied. If flammables are present, the lighting and ventilating equipment should be explosion-proof and properly grounded and bonded. Confined spaces should be properly ventilated during all entry and work.

e) Personal Protective Equipment: Appropriate respiratory protective equipment and body coverings should be provided based on the nature of the hazard. If IDLH atmospheres may be encountered, safety lines and harnesses must be used.

f) If flammable atmospheres are possible, all tools and equipment should be approved for explosive atmospheres and properly grounded and bonded. Employees should never enter an explosive atmosphere.

2) ACCESS CONTROL

a) Entry or Work Permit: An entry or work permit must be posted at the confined space site and signed by the job supervisor when a permit is required. Copies of all permits must be retained through at least the duration of the confined space job. Permits must include atmospheric conditions, test results, ventilation requirements, work and personal protective equipment required. No one should enter the space without reviewing the permit. Permits should be updated at least daily or when conditions change.

b) Work Place Labeling/Posting: The confined space area should be clearly labeled and posted to warn personnel of all possible hazardous atmospheres. This posting should be easily viewed from a distance and is in addition to the Entry/Work Permit (EXAMPLES: DANGER, NO ENTRY, etc.).

3) MONITORING THE WORK AREA

a) Atmospheric Testing: Confined space atmospheres should be tested routinely throughout an operation to detect any change in conditions. Disturbance of scale or residue in the confined space may change conditions rapidly. All tests should be documented on the work permit.

b) Responsible or Competent Person: Someone trained in confined space work must be designated to monitor the work and act as a *safety watch* at all times for the workers in the confined space.

c) ***The safety watch should be in contact with the workers at all times. The monitor must have the same level of personal protective equipment used by the confined space workers in the event that a rescue is necessary.*** Many single entry incidents have turned into multiple fatalities because improperly equipped rescuers tried to aid an unconscious or injured worker in a confined space. See item #8 below: "Attendant's Responsibilities".

4) EMPLOYEE TRAINING AND HEALTH

a) Confined space workers must be well trained in the following areas:

i) Emergency Procedures: Workers must have a complete contingency plan in the event of any emergency.
ii) Personal Protective Equipment: Usage, limitation, etc.
iii) CPR/First Aid
iv) Communications: Visual or audible contact with safety watch at all times.
v) Health: Employees should be certified by physicians as to their capability to wear the required personal protective equipment and perform the required work.

5) HAZARDS OF CONFINED SPACE

a) Asphyxiation is the most common reason for death and injuries, and a hazardous atmosphere is the most common cause of asphyxiation. Other hazards include:
i) Hazardous atmospheres (oxygen deficient, toxins) (65%)
ii) Explosions and fires: These are usually caused by hazardous atmospheres.
iii) Engulfment: Being buried or crushed by loose material within the space. The engulfing material may also be hot or corrosive (13%).
iv) Being struck by falling objects (7%)
v) Heat stress/exposure (6%)
vi) Electrocution (5%)
vii) All others (4%)

6) HOT WORK PERMITS

The permit specifies special steps needed to reduce the hazards of hot work in confined spaces.

a) These requirements often include vessel preparation as follows:
i) Cleaning
ii) Lock-out/Tag-out
iii) Ventilation

b) Hot work also requires special equipment. This equipment should be listed on the hot work permit. Types of special equipment include:
i) Auxiliary lights: Intrinsically safe, can't spark or explode.
ii) Power tools: Low voltage and non-sparking, power cords inspected for fraying.

c) Some equipment rules to follow when conducting hot work in a permit space:
i) Never bring gas cylinders or other large hot work equipment into the space.
ii) Never block entry/exit with equipment.
iii) Shut down during breaks or overnight.

7) ENTRANT'S RESPONSIBILITIES

a) You become an entrant when any part of your body breaks the plane of the permit-required confined space. The entrant must:
i) Know all the hazards within a given space and signs of exposure to these hazards.
ii) Be able to use all personal protective equipment.
iii) Keep in contact with the attendant.
iv) Alert the attendant to any observed hazard or condition not allowed by the permit.
v) Instantly obey any order to evacuate the permit space.

8) ATTENDANT'S RESPONSIBILITIES

a) As the attendant, you are required to know the hazards with the permit space and signs of exposure to hazards within the space.

YOU MUST MONITOR THE ENTRANT'S BEHAVIOR!

b) The attendant must:
i) Keep count of the number of workers in the space and only allow authorized entrants access to the space.
ii) Keep in constant communication with the entrants.

iii) Protect the entrants from external hazards.

iv) Not leave the entrance unless relieved by a qualified attendant.

v) Not enter the space to perform rescues and be able to instantly contact the rescue team.

9) ENTRY SUPERVISOR'S RESPONSIBILITIES

The entry supervisor is responsible for ensuring that the space is safe to enter. He/she will sign the entry permit after ensuring that all acceptable entry conditions are met and permit/checklist is prepared correctly, and cancels the permit and closes the space after all entrants have left the space.

10) RECORD KEEPER'S RESPONSIBILITIES

Maintains descriptions of permit space characteristics and hazards, expired entry permits, and Material Safety Data Sheets.

11) RESCUE TEAM RESPONSIBILITIES

The team must be trained to enter hazardous confined spaces and remove victims.

12) ISOLATION OF ENERGY SOURCES

Accidents can be caused when hazardous materials enter the permit space.

a) Isolating the space is done by the following:

i) Lockout and tagout of all electrical sources.

ii) Blanking and bleeding of hydraulic/pneumatic power sources.

- Blanking means to physically seal pipes by inserting and bolting a piece of metal between flanges in the piping. Some pipes may be isolated with double-valves that can be locked out.
- Bleeding means to release pressure in hydraulic and/or pneumatic lines.

iii) Disconnecting all mechanical linkages that can activate machinery or equipment within the confined space.

iv) Securing all mechanical moving parts within the permit space.

13) ATMOSPHERIC HAZARDS

a) The safest atmosphere is one that is most similar to normal air. The composition of air is 78% nitrogen, 20.9% oxygen, and 1% carbon dioxide or other gases.

b) Confined spaces generally have poor air circulation and non-homogenous atmospheres (you can have different atmospheres within the same space). The types of hazardous atmospheres include:

i) Oxygen deficient – Any atmosphere that has less than 19.5% oxygen by volume.

ii) Combustible or flammable – Any atmosphere with flammable vapors or an oxygen level >23.5%.

iii) Toxic – Any atmosphere containing excessive levels of toxic gases, vapors, mists or dusts.

Note: It is possible to have any combination of these three hazards.

14) BEHAVIOR OF GASES

Vapors have a density. They weigh a certain amount per cubic foot. If the density of the vapor is greater than air, the vapor will settle to the bottom of a confined space. If it is lighter than air, it will rise. In a space, different gases may form layers of stratify. They can also form pockets that are quite stable and persist for long periods of time. That is why you need to sample the air at all levels before entering a permit space.

15) IDLH ATMOSPHERES

a) An IDLH (Immediately Dangerous to Life and Health) atmosphere is one in which a toxic, corrosive, or asphyxiating substance:

i) Poses an immediate threat to life.

ii) Would cause irreversible or immediate adverse health effects.

iii) Would interfere with an individual's ability to escape.

16) DETECTING HAZARDOUS ATMOSPHERES

Human senses (sight, smell, taste) cannot protect you from hazardous atmospheres. Some gases have no taste or odor. Detection requires the use of electronic monitoring equipment.

17) OXYGEN DEFICIENT ATMOSPHERES

Oxygen deficiency is the leading single cause of death in confined space. Any oxygen level below 19.5% is deficient, and it is common in spaces with little or no ventilation. Common causes of oxygen deficiency include:

a) Displacement – The introduction of other gases into the space may displace the oxygen. These gases might flush it out, force it up and out of the space, or cause it to settle to the bottom, depending on density of the gases and the characteristics of the space.

b) Bacterial Action – The decomposition of organic matter such as sewage, leaves, grass, and wood can use available oxygen.

c) Oxidation – Whenever metals oxidize (rust) it absorbs atmospheric oxygen.

d) Combustion – Burning, welding, heating, or cutting within a confined space uses quantities of oxygen. The oxygen usually combines with carbon to form carbon dioxide or carbon monoxide, both of which are toxic.

e) Absorption – Some materials (such as wet activated carbon) will absorb oxygen.

18) SYMPTOMS OF OXYGEN DEFICIENCY

Symptoms of oxygen deficiency appear when the level drops below 19.5%. They worsen as the oxygen level decreases. As the level of O_2 falls, ALL persons in the environment suffer the following:

a) Loss of coordination. This can impede self-rescue.

b) An increase in pulse and respiration.

c) Impaired judgment.

d) Oxygen levels and related symptoms are as follows:

e) Percent of Oxygen Symptoms

- 19.5% Minimum permissible level
- 15-19% Possible impaired coordination
- 12-14% Respiratory/pulse increase, impaired judgment/coordination
- 10-12% Further increase in respiration/pulse
- 8-19% Fainting, nausea, vomiting, blue lips
- 6-8% 4-5 minutes – recovery with treatment
  6 minutes – 50% mortality
  8 minutes – 100% mortality
- 0-6% Coma in 40 seconds or less

19) COMBUSTIBLE ATMOSPHERES

To burn, an atmosphere must have the following:

a) Sufficient oxygen.

b) Sufficient fuel to burn and continue the combustion chain reaction. The amount of fuel needed depends on the level of oxygen, which is why you never ventilate a confined space with oxygen.

c) A source of ignition – This can be an open flame, a spark, or a hot piece of metal.

20) FORMS OF FUELS

There are two basic forms of fuels as follows:

a) Gases – These include methane, hydrogen and the vapor from the evaporation of a flammable liquid such as alcohol or gasoline.

b) Particulate – These are a suspension (cloud or mist) of flammable particles or liquids. A combustible particulate hazardous atmosphere exists when the concentration of airborne, flammable dust obscures vision at a distance of 5' or greater, depending on the flammability of the particles.

21) FLAMMABILITY RANGES – UEL AND LEL

a) A fuel can burn only if it is mixed with oxygen in the right proportion. If there is too much air, the fuel/air mixture is too lean to burn; too much fuel means the fuel/air mixture is too rich to burn.

b) The UEL and LEL are the limits determine whether a fuel/air mixture can burn:

i) Upper Explosive Limit (UEL) beyond which a fuel is too rich to burn.

ii) Lower Explosive Limit (LEL) below which the fuel is too lean to burn.

iii) Between the UEL and LEL lies the potential for explosion.

c) Some gases (acetylene) have no UEL. They will burn at 100% concentrations.

22) TOXIC ATMOSPHERES

A toxic atmosphere is present whenever gases, dusts, mists, or vapor exist in concentrations that can cause illness or injury. Definition – Gases, dusts, mists, or vapors present in concentrations above the permissible limits.

23) SOURCES OF ATMOSPHERIC TOXINS

Depending on the nature of the confined space, there are many possible sources of toxins:

a) Bacterial action (decay) of materials within the confined space.
b) Products or chemicals that were (or are) stored in the confined space. Even after a space has been cleaned, toxins can be released from walls and other surfaces.
c) Substances (cleaners or solvents) brought into the confined space.
d) Work being performed – Cleaning, welding, sandblasting and painting – can release toxins.
e) Areas next to the confined space: work activities can release toxins and contaminate the atmosphere.

24) MEASURING TOXICITY

Permissible Exposure Limit (PEL) identifies the exposure limit of an unprotected worker to a particular toxic substance. Different substances have different PELs.

a) Time Weighted Average (TWA) is the simple arithmetic average of work exposure over time. It is usually calculated on an 8 hour exposure basis.
b) Threshold Limit Value (TLV) is another method commonly used to measure exposure. It is usually lower than the PEL.
c) Short Term Exposure Limit (STEL) is a 15 minute TWA exposure; some gases and vapors have a maximum short term exposure that is greater than the 8 hour TWA.
d) Ceiling Concentration (C) is the highest concentration of toxic substances that workers can be exposed.

25) TYPES OF EQUIPMENT

Equipment performs the following functions:

a) Detects hazards before and during entry. Examples include atmospheric monitors.
b) Enables attendants to contact entrants and rescue team – e.g. radios, phones, and whistles.
c) Protects entrants from hazards. Examples include respirators, fall protection equipment, lifelines, and retrieval lines.

26) USING ATMOSPHERIC MONITORS

a) Atmospheric monitoring means using an electronic instrument to measure the concentrations of the following types of gases:
    i) Oxygen – The level must be between 19.5 and 23.5%.
    ii) Combustibles – Any level of combustibles above 10% LEL is hazardous.
    iii) Toxic gases – Permit spaces may contain one or more toxic gases. Commonly encountered toxins include carbon monoxide and hydrogen sulfide, but there are literally hundreds more depending on the type of space and industrial process.
b) Monitors have a sensor that reacts with the gas. The sensor produces an electrical resistance in proportion to the amount of gas it detects. The monitor then measures this resistance and gives you readout of the amount of gas.

27) TYPES OF MONITORS

Many monitors can be fitted with hoses or extensions so gas concentrations can be measured in Remote locations. These are sophisticated electronic devices, and they are not fool-proof. Unless used properly, they give false readings.

a) Some are hand-held and can be worn while working.
b) Some are fixed and mounted in cabinets at a single location.
c) They all have some type of readout and either a visual or audible alarm.

28) CALIBRATION/ZEROING

a) Calibration means exposing the monitor to a sample of air with known levels of gases.
b) Temperature, pressure, and humidity also can affect some readings.
c) To check the accuracy of the combustible and toxin monitors, a sample gas must be used. Sample gases are contained in small, pressurized cylinders and the concentration of the toxin or combustible is listed on the label.

d) The monitor's sensors are exposed to the sample gas, and the readout should be the same as the composition of the sample gas. The monitor's manual describes the exact steps needed to calibrate that specific unit.

29) ASSESSING AIR QUALITY

Check for toxic breathing environment if the possibility for one exists. If possible, the initial air sampling should be done before opening the space.

a) Insert your gas detector probe into a pick-hole or sample hole. If this is impossible, gently crack the opening just enough to test the atmosphere. ***Note:*** Most explosions and fires occur at point of entry!

b) Test for oxygen first, since a low oxygen level will result in an artificially low combustible level readout. In addition, oxygen levels must be raised before the space can be entered.

c) Once the oxygen level is established, next determine the presence of combustibles/toxins.

d) Test all levels including lowest level, breathing zone, above breathing zone, and below ceiling.

30) USING MONITORS

a) Monitors are essential pieces of equipment that can keep you from becoming another statistic.

b) Before you ever breathe any air in a confined space, you should test it and determine the types of atmospheric hazards present.

c) An inaccurate monitor will not protect you at all. You should always calibrate and zero a monitor before using it. You also should ensure that the alarms are working, and that you will be able to see and hear them in the confined space environment.

31) LIMITATIONS OF AIR-SUPPLYING RESPIRATORS

The biggest risk of these devices is that you will lose your air supply. Some of these devices incorporate high-efficiency cartridges designed to allow you time to escape. The cartridges must be designed for the type of hazard encountered in the atmosphere. Some respirators have a small of air that will give an entrant time to exit the space.

32) RESPIRATOR RESTRICTIONS

a) Every respirator is designed for a specific purpose, and if you use a respirator for anything other than its intended purpose, you risk injury and your death.

Unless specified on the NIOSH Approval Label furnished with the respirator, air-purifying and air line respirators must <u>not</u> be used when:

i) The oxygen level is below 19.5%.

ii) Levels of toxins in the air are unknown.

iii) You are in an unventilated confined space where the level of contaminants may be higher than the limits specified on the respirator.

iv) The atmosphere is IDLH.

v) You are fire-fighting.

b) Air purifying respirators must not be used for protection against substances that cannot be tested, smelled, or felt. The cartridges have limited service lives, and a cartridge can fail without warning.

c) Some contaminants can be absorbed through the skin or the eyes. In these cases appropriate protective equipment must be worn.

d) No one may use any kind of respirator unless they have received all necessary training and have been awarded certification.

33) HARNESSES/TRIPODS

a) These devices can assist the attendant to retrieve the victim in some situations. They are useful for work in permit spaces that are IDLH, have a vertical entry or that pose a risk of engulfment.

b) These retrieval devices may not work if the victim falls behind machinery or obstacles in the space.

34) VENTILATORS

a) Blowers and ventilators are used to purge hazardous atmospheres. They have an effective capacity in CFM (cubic feet / minute) that determines purge times. Purge times must be listed on the permit.

b) While purging, the dropped end of the hose should:

i) Hang vertically
ii) Be more than 1' below ceiling
iii) Be not more than 2' above the floor

c) When using a blower, make sure that:
i) The blower intake is away from traffic to avoid vehicle exhaust.
ii) The exhaust from gas-powered blowers is not being sucked into the blower air intake.
iii) The blower intake is at least 5' away from confined space entry.

35) PERMIT COMPLIANCE

a) Read the permit and note the hazards. Do they align with what you know about the space?
b) Note the safety equipment required. Does it address all the hazards mentioned? Is the equipment available and have you inspected it?
c) Look at the list of required tools. Are they available and have they been inspected?
d) Check the list of authorized entrants and attendants. Do they have the skill they need?
e) Go through the preparation checklist. Do you have all the equipment to perform the required steps? Have all the steps been taken?
f) Read the atmospheric tests specified. Do you have the monitors needed to make the measurements? Is the equipment operating properly? Have the monitors been calibrated and zeroed?
g) Does the space need to be isolated? Has that been done?
h) Does the space need to be ventilated? Has that been done? Ventilation should include 5 exchanges of air.
i) During entry you should continuously ventilate and monitor.
j) Hazardous atmospheres are the biggest dangers you face, so the entrant, attendant, and authorizer do the pre-entry testing and verification. Authorizer has the legal responsibility, but entrant and attendant should also assume responsibility.
k) The authorizer will cancel the permit after the entry is completed.

36) EMERGENCY PROCEDURES

a) The easiest emergency to deal with is one that never occurs.
b) An order to evacuate the space should be made whenever:
i) The oxygen level drops below 19.5%, or rises above 23.5%.
ii) The level of combustible rises above 10% of LEL.
iii) Concentrations of toxins rise above permissible limits.
iv) Conditions outside the confined space endanger the entrants.
v) Any other conditions arise that are not included on the entry permit.
vi) The attendant must leave his or her post.
c) At the first sign of changing conditions, the attendant should take the appropriate action because:
i) Work tasks may stir up additional toxins.
ii) Exit might take longer than expected.
iii) Cause of contamination may suddenly worsen.

37) INITIATING AN EVACUATION

a) The authorizer, entrant or attendant may order an evacuation of the confined space. When ordered to do so, all entrants must evacuate a confined space *immediately*. The permit form will list steps to take if there is a problem. It will describe how to contact the rescue team (phone, radio, etc.).
b) The attendant should be ready to tell the rescuers:
i) The number of entrants
ii) Condition of the entrants (if known)
iii) The cause of the emergency