Carnegie Mellon University Environmental Health & Safety FIRE | LAB | WORK	**Environmental Health and Safety** **Confined Space Program**
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1. Purpose

The purpose of this Confined Space Program is to protect Carnegie Mellon University (CMU) faculty, staff (herein referred to as "employee"), and contractors, from the hazards associated with Confined Space entry.

2. Scope

This program establishes the minimum requirements to enter Confined Spaces. The goal of this program is to prevent injuries to CMU faculty, staff, and contractors by incorporating the federal requirements found within Occupational Safety and Health Administration (OSHA) 29 CFR 1910.146 Permit-Required Confined Space and OSHA 1926 Subpart AA. The information within this document shall be used to define roles and responsibilities, identify and label Confined Space locations owned by CMU, conduct pre-planning of Confined Space entries, outline entry procedures, highlight emergency response and rescue operations, address employee training, guide contractor collaboration, and perform periodic audits.

3. Definitions

3.1. **Acceptable entry conditions** - the conditions that must exist in a Permit Required Confined Space (PRCS) to allow entry. These conditions ensure employees involved in the entry can safely enter into and work within the space.

3.2. **Attendant** - a trained CMU employee who is stationed outside one or PRCS, within reasonable and visual proximity, who monitors the Authorized Entrants and who performs all assigned Attendant duties.

3.3. **Authorized Entrant** - a trained CMU employee who is authorized to enter a PRCS.

3.4. **Blanking or blinding** - the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

3.5. **Breathing Zone** - the zone within a 0.3-meter (or 10 inch) radius of a worker's nose and mouth, and it has been generally assumed that a contaminant in the breathing zone is

homogeneous and its concentration is equivalent to the concentration inhaled by the worker.

3.6. **Confined space** - a space that is:
- Large enough for the whole body to enter and perform assigned work,
- Has a limited or restricted means of entry or exit (this is not related to the amount of entry exit points; limited entry or exit occurs when a person must make adjustments to enter/exit the space such as climbing a ladder or crawling through a smaller opening), **and**
- Is not designed for continuous occupancy (spaces designed for human occupancy will contain ventilation, lighting, hazard-free walking/working surfaces, etc.)

3.7. **Double block and bleed** - the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

3.8. **Emergency** - any occurrence (including the failure of hazard controls or monitoring equipment) or event, that is internal or external to the Confined Space, which could endanger Authorized Entrants.

3.9. **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.

3.10. **Entry** - the action by which **<u>any</u>** part of the Entrant's body breaks through the plane of an opening into a Confined Space.

3.11. **Entry Permit** - the written or printed document that is provided to allow and control entry into a PRCS.

3.12. **Entry Supervisor** - a trained CMU employee who is responsible for determining if acceptable entry conditions are present in a PRCS, authorizing entry, assigning entry conditions, overseeing entry operations, initiating emergency procedures and terminating entry.

3.13. **External rescue service -** the personnel designated to rescue Entrants from Confined Spaces.

3.14. **Hazardous atmosphere** - an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness from one or more of the following causes:
- Oxygen deficient atmosphere, below 19.5%
- Oxygen enriched atmosphere, above 23.5%
- Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).
- Airborne combustible dust at a concentration that meets or exceeds its LEL, which can be approximated as a condition, where dust obscures vision at a distance of 5 feet or less.
- Atmospheric concentration of any substance for which a dose or permissible exposure limit (PEL) is published by OSHA, and which could result in employee exposure in excess of its dose, PEL, or short-term exposure limit (STEL).

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

3.15. **Hot work** - any work that involves burning, welding, cutting, brazing, soldering, grinding, using fire or spark-producing tools, or other work that produces a source of ignition or spark.

3.16. **Hot work permit** - the written authorization to perform hot work operations.

3.17. **Immediately dangerous to life or health (IDLH)** - any condition that poses an immediate or delayed threat to life, or that would cause irreversible adverse health effects, or that would interfere with an individual's ability to escape unaided from a Confined Space.

3.18. **Intrinsically safe** - a rating given to electrical equipment that verifies its capabilities to be used in hazardous atmospheres without supplying enough energy to create an explosion.

3.19. **Isolation -** the process by which a PRCS is completely protected against the release of energy and material into the space by means of:
- blanking or blinding,
- misaligning or removing sections lines, pipe, or ducts,
- a double block and bleed system,
- lockout/tagout of all sources of energy, or
- blocking or disconnecting all mechanical linkages.

3.20. **Line breaking** - the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

3.21. **Non-Permit Confined Space** - A space that does not contain, or with respect to atmospheric and physical hazards, have the potential to contain, any hazard capable of causing death, serious physical harm or significantly impede the ability to escape the space. These spaces require no prior approval or documentation for entry.

3.22. **Oxygen deficient atmosphere** - an atmosphere containing less than 19.5% oxygen.

3.23. **Oxygen enriched atmosphere** - an atmosphere containing more than 23.5% oxygen.

3.24. **Permit Required Confined Space** (**PRCS**)- A Confined Space that may contain **ANY** of the following characteristics:
- Contains, or has the potential to contain, a hazardous atmosphere,
- Contains a material that has the potential for engulfing an Entrant,
- 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 smaller cross-section, or
- Contains any other recognized serious safety or health hazard.

3.25. **Prohibited condition** - any condition in a PRCS that is not allowed by the Entry Permit during the period when entry is authorized.

3.26. **Retrieval system** - the equipment used for non-entry rescue of persons from Confined Spaces, usually a tripod and winch.

3.27. **Testing** - process of identifying and evaluating the hazards that Entrants may encounter during entry into a PRCS.

3.28. **Unauthorized Entrants** - Anyone not properly trained in Confined Space entry or anyone not following a Confined Space entry program.

3.29. **Ventilation supplying equipment** - equipment used to provide positive or negative ventilation to control atmospheric levels inside of a Confined Space. This may include fans, vacuums, or other air moving devices.

4. Roles and Responsibilities

4.1. Environmental Health and Safety (EHS):

4.1.1. Maintains the most updated version of the Confined Space Entry Program, and ensures it is accessible to employees.

4.1.2. Maintains a master list of all identified Confined Spaces on CMU's campus.

4.1.3. Provides updated lists of CMU Confined Spaces, their classes, hazards, and locations, to CDFD, FMCS, and the City of Pittsburgh EMS Rescue Teams.

4.1.4. Contacts external rescue services (City of Pittsburgh EMS Rescue Teams) to communicate the intention for CMU employees to enter a Confined Space, as well as the Confined Space location and associated hazards.

4.1.5. Provides authority for any external rescue service to access any PRCS for the purpose of developing rescue plans or participating in rescue drills.

4.1.6. Assess areas on campus for Confined Spaces. Classify and post proper Confined Space signage in required areas. A sign reading, "DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" or other similar language will be used.

4.1.7. Determine and identify the steps to be taken to reclassify a PRCS.

4.1.8. Perform Entry Supervisor duties.

4.1.9. Develop and deliver Confined Space entry training to Authorized Entrants, Attendants, and Entry Supervisors.

4.1.10. Maintain Confined Space monitoring equipment, including manufacturer required calibration, and send any damaged monitoring equipment to an approved vendor/service provider for repair.

4.1.11. Maintain permits for at least 3 years after the permit has been closed.

4.2. Facilities Management and Campus Services (FMCS):

4.2.1. Identify employees who will be required to participate in Confined Space entries as part of their duties. Maintain an accurate list of these employees and update it as needed.

4.2.2. Ensure that all employees required to participate in Confined Space activities are properly trained prior to assignment. Authorized Entrants must receive training prior to entering and/or performing work within Confined Spaces.

4.2.3. Ensure that the proper safety equipment required for Confined Space entry is made available to employees.

4.2.4. Communicate to EHS when a Confined Space entry is needed. Communicate this as soon as possible, and in cases other than an emergency, not less than 48 hours prior

to the desired entry date. This can be done by emailing safety@andrew.cmu.edu with the details of the Confined Space entry to include: date, location, scope of work, contractor involvement and known hazards.

4.2.5. Notify EHS when a new Confined Space is created or identified.

4.2.6. Include in any contracts the updated list of Confined Spaces.

4.2.7. Notify EHS when Confined Space entry will be required by contractors. Ensure contractors are familiar with section 5 of this Program.

4.2.8. Provide contractors with information required for confined space entry. This must include all known hazards of the space.

4.2.9. Ensure that all provisions of this Confined Space Program are followed.

4.3. Campus Design and Facility Development (CDFD)

4.3.1. Notify EHS when Confined Space entry will be required by contractors. Ensure contractors are familiar with section 5 of this Program.

4.3.2. Notify EHS when the creation of a new Confined Space is planned.

4.3.3. Collaborate with EHS and FMCS to determine design details of new Confined Spaces.

4.4. FMS employees:

4.4.1. Observe all practices and procedures contained in this Confined Space Program.

4.4.2. Do not enter Confined Spaces without proper training.

4.4.3. Attend designated training sessions.

4.4.4. Maintain equipment per the manufacturer's recommendations.

4.4.5. Inspect Confined Space entry equipment prior to use and report any damaged equipment to the appropriate supervisor.

4.4.6. Report hazardous or unsafe conditions to their supervisor, the Entry Supervisor, and EHS.

4.5. Confined Space Committee:

4.5.1. Review and update this Confined Space Entry program at least annually.

4.6. Entry Supervisors:

4.6.1. Attend Confined Space training at required intervals.

4.6.2. Know the hazards, including the method of exposure, signs or symptoms, and the consequences of exposure, that may be faced during entry.

4.6.3. Identify and recommend corrective actions that are needed to protect against known and anticipated hazards involved with the Confined Space entry. Document the corrective actions on the Confined Space permit.

4.6.4. Ensure all equipment specified by the Confined Space permit is available prior to endorsing and authorizing entry into the Confined Space.

4.6.5. Conduct pre-entry atmospheric monitoring and ensure that continuous monitoring is conducted and documented. Document results of atmospheric testing on the Entry Permit.

4.6.6. Conduct an inspection of the Confined Space to identify physical hazards. Record physical hazards and equipment or procedures needed to abate these hazards on the Entry Permit.
4.6.7. Verify with EHS that external rescue services have been notified of the Confined Space entry. Ensure that the means for contacting external rescue services are in place and known by the Entrants and Attendants.
4.6.8. Authorize Confined Space entry in accordance with the Entry Permit. Sign the Entry Permit to document this authorization.
4.6.9. Terminate the permit when entry operations have been completed or when a prohibited condition arises. Verify that the hazardous situation or prohibited condition has been properly eliminated before obtaining or authorizing a new Entry Permit.
4.6.10. Ensure that unauthorized Entrants are aware that they are prohibited from entering the Confined Space.
4.6.11. Ensure that entry operations remain consistent with the terms of the Entry Permit, and that acceptable entry conditions are maintained.

4.7. Attendants:
4.7.1. Attend Confined Space training at required intervals.
4.7.2. Know the hazards, including the method of exposure, signs or symptoms, and the consequences of exposure that may be faced during entry.
4.7.3. Understand and be able to identify the possible behavioral effects of hazardous exposures in Authorized Entrants.
4.7.4. Inspect all Confined Space entry equipment (monitoring equipment, emergency retrieval equipment, harness, etc.) to ensure proper working order prior to entry.
4.7.5. Read and understand the limitations/requirements provided by the Entry Permit. Do not allow Authorized Entrants to enter the Confined Space until all Entry Permit requirements have been fulfilled.
4.7.6. Ensure that unauthorized Entrants are aware that they are prohibited from entering the Confined Space.
4.7.7. Maintain an accurate count and roster of the Authorized Entrants within the permit space.
4.7.8. Remain outside the permit space during entry procedures until relieved by another Attendant.
4.7.9. Communicate with Authorized Entrants regarding air monitoring status, every 30 minutes, or as often as necessary, when new readings are documented, and communicate if there is a need to evacuate the space.
4.7.10. Monitor the activities inside and outside the permit space to determine if it's safe for Entrants to remain in the space.
4.7.11. NEVER enter the Confined Space for rescue operations.

4.7.12. Order Authorized Entrants to evacuate the permit space under any of the following conditions:
- If a prohibited condition is detected;
- If behavioral effects of hazard exposure are detected in an Authorized Entrant;
- If the Attendant detects a situation outside the space that may endanger the Authorized Entrants; or
- If the Attendant cannot effectively and safely perform all the duties required or must leave the area without proper relief.

4.7.13. Perform rescue from outside of the Confined Space using retrieval equipment.

4.7.14. Summon external rescue services as soon as it is determined that Authorized Entrants may need more assistance to escape from the permit space. Complete this action using the method that was determined before entry was authorized.

4.7.15. Perform NO other duty or activity that may distract or interfere with the primary duties to monitor and protect the Authorized Entrants.

4.8. Authorized Entrants:

4.8.1. Attend Confined Space training at required intervals.

4.8.2. Know the hazards, including the method of exposure, signs and symptoms, and the consequences of exposure that may be faced during entry.

4.8.3. Inspect all Confined Space entry equipment (monitoring equipment, emergency retrieval equipment, harness, etc.) to ensure proper working order prior to entry.

4.8.4. Understand how to properly use Confined Space entry equipment.

4.8.5. Read and understand the limitations/requirements provided by the Entry Permit. Do not enter the Confined Space unless all Entry Permit requirements have been fulfilled.

4.8.6. Remain in constant communication with the Confined Space Attendant regarding the air monitoring status and any need to evacuate the space. This can include two-way radios, cell phones, visual contact, voice contact, line pulls, or other agreed upon methods.

4.8.7. Alert the Attendant when any warning signs or symptoms of exposure to a hazardous situation or a prohibited condition arises.

4.8.8. Exit the Confined Space as quickly as possible whenever an evacuation directive is given by the Attendant or Entry Supervisor.

4.8.9. Exit the Confined Space when a hazardous situation develops or a prohibited condition arises.

4.8.10. Perform self-rescue when necessary and possible.

4.8.11. Never introduce an unplanned hazard into a Confined Space.

5. Contractors

5.1. Contractors will not be authorized to enter a CMU owned PRCS without fulfilling the contractor's requirements of this program.

5.2. Employees of contractors, customer personnel, or other non-authorized individuals, are prohibited from accessing a CMU owned PRCS under a CMU Confined Space Entry Permit. The permit, and its parameters, identified by CMU's Entry Supervisor, will not be offered or extended to individuals other than authorized CMU personnel.

5.3. Contractors may enter a CMU owned PRCS after providing their own Confined Space entry program for review by CMU EHS. Upon CMU EHS approval, contractors may enter a CMU PRCS using the contractors own entry procedures, to include: Entry Supervisor and Attendant, atmospheric monitoring, permitting process, employee training, and entry equipment.

5.4. Before contractor Confined Space entry may occur:

- Contractors must communicate their intent to enter a CMU owned PRCS a minimum of 48 hours prior to contractors' desired entry date and time. Contractors may communicate this to the CMU Project Manager or CMU's EHS;
- Contractors must provide CMU with full scope of work related to Confined Space entry, Safety Data Sheets for any hazardous materials used, and information on any additional hazards that contractor may create such as hot work, painting, chemical cleaning, etc.;
- Contractors must obtain a hot work permit from CMU if hot work is to be conducted within the Confined Space; and
- CMU must provide contractors with information on existing or potential hazards related to the PRCS, any historical data needed by the contractor regarding the space, and contact information of all other contractors working concurrently in the same Confined Space.

5.5. Any time that multiple entities, including CMU, will enter a Confined Space concurrently, a pre-job planning meeting must occur with a representative of each entity who is knowledgeable in the scope of work. A CMU EHS representative or Entry Supervisor must attend this meeting.

6. Training Requirements

6.1. Each training session will cover this Confined Space Program and all the necessary requirements set forth in the OSHA Standard 29 CFR 1910.146 to ensure each CMU employee regulated by this standard has the understanding, knowledge, and skills necessary for the safe performance of their duties.

6.2. CMU will not train outside contractors/subcontractors on Confined Space entry.

6.3. Training and/or retraining will be provided (by EHS) to each affected person according to the following:

6.3.0. Before an employee is assigned duties under this program.

6.3.1. Before there is a change in assigned duties.

6.3.2. Whenever a new hazard is introduced within a Confined Space, this training must occur before any entry involving the new hazard is authorized.

6.3.3. Upon identification or creation of a new Confined Space with a new configuration or hazards.

6.3.4. Whenever there are sufficient reasons to believe that there are deviations from Confined Space entry procedures, or there are inadequacies in the personnel's knowledge or use of these procedures.

6.3.5. Whenever there are significant changes made to this program.

6.4. SciShield shall be used to post and register for available training sessions.

7. Identification and Labeling of Confined Spaces

7.1. All grounds and facilities at CMU will be evaluated by EHS for the presence of Confined Spaces. FMCS and CDFD must notify CMU EHS of any Confined Space that has not been documented and classified. Notification shall be given by emailing safety@andrew.cmu.edu.

7.2. CMU EHS will classify and label all known Confined Spaces on CMU property as a Confined Space or PRCS in accordance with the OSHA regulation. CMU EHS will maintain a master list of Confined Spaces to include: location, classification, hazards, and reclassifying instructions/requirements. This list will be provided to FMCS and CDFD through access to Box folders. The master list will be updated upon new identification, or new classification, of Confined Spaces.

8. Prevention of Unauthorized Entry

8.1. CMU will take precautions to prevent unauthorized entry into Confined Spaces. The primary means for preventing unauthorized entry will be through signage and training.

8.2. Locks, barriers/barricades, and/or banner tape may also be used to identify and isolate open Confined Space areas.

8.3. Attendants and Entry Supervisors are also responsible for preventing unauthorized entry into Confined Spaces during Confined Space entry operations.

9. Planning and PRCS Entry Requests

9.1. When planning jobs, tasks, or operations that will or may require entry into a PRCS by CMU employees or outside contractors, CMU EHS must be notified as soon as possible, but no later than 48 hours prior to the desired entry date and time, unless an emergency situation occurs. This can be accomplished by emailing safety@andrew.cmu.edu with the details of the Confined Space entry to include: **date, location, scope of work, contractor involvement, and known hazards.** This notification to EHS is the primary method to request a PRCS Entry Permit.

9.2. Upon notification of an entry request, EHS will notify external rescue services (City of Pittsburgh EMS Rescue Team) of CMU's intent to enter a Confined Space. This will be accomplished by emailing the point of contact for the external rescue service and providing the following information:

9.2.0. Date, time, and estimated duration of the Confined Space entry.

9.2.1. Location of the Confined Space to include special access instructions if necessary.

9.2.2. Hazards inherent to the Confined Space or created by the scope of work.
9.2.3. Contact information of the Entry Supervisor to assist external rescue services if needed.

9.3. The current POC for the External Rescue Service is Chief Anthony Darkowski. His contact information is: anthony.darkowski@pittsburghpa.gov

9.4. EHS will initially act as the CMU Entry Supervisor and will lead coordination of PRCS entries.

9.5. In an emergency situation where access to a PRCS is needed in less than 48 hours, contact EHS by dialing the EHS emergency hotline 412-268-8182.

9.6. CMU employees are not authorized to enter a Confined Space before adhering to the entry procedures listed in this program.

10. CMU Employees Entering a Non-CMU Owned Confined Space

10.1. If a Confined Space is owned by any entity other than CMU, including areas leased by CMU, and is to be entered by any CMU employee, the following must occur BEFORE entry:

- CMU EHS must be notified by emailing safety@andrew.cmu.edu. This notification will also serve as a request for a Confined Space Entry Permit;
- Owning entity of the Confined Space must be notified of CMU's intent to enter the Confined Space;
- Owning entity must be briefed on the scope of work that will occur in the Confined Space and all associated hazards;
- The owners of the space must supply CMU EHS or Project Manager with a list of actual or potential hazards associated with the Confined Space;
- The owners of the Confined Space must provide CMU EHS or Project Manager with any historical background associated with the Confined Space; and
- The owners of the Confined Space must communicate to CMU EHS or Project Manager any work being done in the Confined Space that may affect CMU employees during entry. This information must include: who is responsible for the work and their contact information, the scope of the project, and the potential hazards associated with the work.

10.2. If communication with the space owner does not occur, entry into the Confined Space should not be performed.

10.3. CMU employees may only perform a Confined Space entry after the requirements of this program have been fulfilled by a CMU Entry Supervisor. CMU employees are not authorized to enter Confined Spaces under the supervision of an entity other than CMU.

11. Permit System

11.1. An Entry Permit is a document required to be completed by a CMU Entry Supervisor prior to entering a PRCS. No PRCS entry may occur until a permit has been filled out, authorized, and posted. The Entry Permit shall contain the following information:

- Location of the Confined Space,

- Date of entry,
- Permit duration,
- Scope of work,
- Name of the Entry Supervisor,
- Names of the authorized Entrants and Attendants,
- Acceptable entry conditions,
- Date, time, and results of initial atmospheric testing,
- Date, time, and results of continued atmospheric testing,
- Initials of those conducting atmospheric tests,
- Safe values of common/expected atmospheric hazards,
- Additional Entry Supervisor safety requirements,
- Emergency response contact instructions and information, and
- Entry Supervisor authorization signature.

11.2. Notifying EHS by emailing of a PRCS entry shall be accomplished by emailing safety@andrew.cmu.edu and will also serve as requesting a Confined Space Entry Permit.

11.3. The Entry Supervisor will use the Confined Space permit to document the results of initial atmospheric tests and physical inspection of the PRCS.

11.4. The Entry Supervisor will document additional safety requirements on the permit such as: the use of lockout/tagout procedures, hazard isolation procedures, material substitutions, ventilation, PPE, respirator and specific cartridges, fall protection, rescue equipment, lighting, etc. These requirements will be considered mandatory for Confined Space entry.

11.5. Deviation, lack, malfunction, or ineffectiveness of the Entry Supervisor's requirements will be considered a prohibited condition and Entrants must exit the space immediately. Re-entry will not be authorized until requirements can be fulfilled effectively.

11.6. After the Entry Supervisor requirements have been fulfilled, the Entry Supervisor will sign the Entry Permit to authorize entry into the Confined Space. Entry permits which have not been signed by the Entry Supervisor, will not be considered valid.

11.7. Once authorized, the Entry Permit must remain visible or available on-site, and will serve as labeling of a Confined Space.

11.8. When actual or potential atmospheric hazards exist, the Attendant will record continuous atmospheric testing results on the permit every 30 minutes.

11.9. Entry permits can be terminated and/or canceled, by the Entry Supervisor when:

- The pre-entry operations are not completed or discussed with Entrants;
- Atmospheric conditions become unsafe or an IDLH atmosphere develops;
- Safety requirements described by the permit are not maintained;
- Conditions prohibited by the Entry Permit arise in or near the permit space;
- The scope of work changes;
- New hazards, hazardous material, or chemicals are introduced into the space;
- The projected work is completed; or
- The permit has reached the end of its authorized duration.

11.10. An Entry Permit will be considered closed or canceled when the Entry Supervisor removes the permit from the Confined Space entry site.

11.11. All closed/canceled Entry Permits are to be returned to the EHS department for proper record keeping for a period of 3 years after the date the Entry Permit has expired.

11.12. Any problems encountered during Confined Space operations must be recorded on the Entry Permit.

12. Entry Procedures for PRCS Entry

PRCS entry procedures shall be observed when all hazards (hazardous or IDLH atmosphere, engulfment, entrapment, or other recognizable serious safety hazard) cannot be eliminated prior to entry into the Confined Space. The following are steps to be taken, in order, to enter a PRCS.

12.1. Hazard Elimination - Isolation

12.1.0. Isolating a permit space by removing it from service and ensuring it is completely protected against the release of energy or materials is the preferred control to be utilized. Isolation of a space should always be utilized when feasible and should occur before entry. **NOTE: Control of hazards through isolation constitutes elimination of the hazards.**

12.1.1. Isolation of a permit space can be accomplished through:

- Lockout/Tagout procedures;
- Blanking and blinding of piping systems carrying materials with the potential to create a hazardous or explosive atmosphere;
- Misaligning or removing sections of pipes or ducts;
- Double block and bleed methods; or
- Blocking or disconnecting of all mechanical linkages.

12.1.2. After isolation controls/methods have been implemented, an Entry Supervisor must validate their effectiveness through testing and inspection of the space.

12.1.3. Once isolation has been determined to be effective, periodic atmospheric testing in the space may be utilized instead of continuous monitoring. Periodic monitoring is to be accomplished, and recorded on the Entry Permit, every 30 minutes.

12.1.4. If isolation methods are able to be implemented without entry into the space, all PRCS hazards are eliminated, and hazard elimination is verified by an Entry Supervisor's test and inspection, the space is eligible to be reclassified to a non-PRCS Confined Space.

12.1.5. Any entry where isolation would be required but is considered infeasible, will require continuous monitoring throughout the duration of the entry, with results recorded on the Entry Permit every 30 minutes. Entry without isolation of hazards may or may not be granted by the Entry Supervisor.

12.2. Engineering Controls - Ventilation

12.2.0. When isolation is infeasible or ineffective on its own, Confined Spaces may require ventilation prior to entry, and must be ventilated continuously while entry operations are in progress. **NOTE: Control of atmospheric hazards through forced air or negative**

ventilation does not constitute elimination of the hazards. Elimination of the hazards means the hazards no longer exist.

12.2.1. Entry into the Confined Space will not occur until ventilation has been used to control or eliminate a hazardous atmosphere if one exists.

12.2.2. Forced air ventilation will be directed as to ventilate the immediate areas where an Entrant is, or will be, present within the space and will run continuously until all Entrants have left the space. If the ventilation supplying equipment stops running for any reason, Entrants shall be directed to exit the space immediately and not re-enter until ventilation can be reestablished, and its effectiveness verified by air monitoring.

12.2.3. The air supply will be from a clean source and may not increase the hazards in the space. Be sure that air used for ventilation is not contaminated from common sources such as nearby vehicle exhaust, generator exhaust, exhaust from running equipment such as compressors or landscaping equipment, paint vapors, cleaning chemical vapors, etc.

12.2.4. Positive pressure ventilation of a space may not increase the hazards in a surrounding or connected space. Positive pressure ventilation has the ability to move an atmospheric contaminant from one Confined Space to another connected space.

12.2.5. Intrinsically safe ventilation equipment must be used when ventilating an actual or potentially explosive atmosphere. This includes any occurrence where flammable vapors are being ventilated. Common flammable vapor sources may include fuel vapors, paint vapors, aerosols, adhesives, etc.

12.2.6. The atmosphere within the space must be tested continuously, and recorded once every 30 minutes on the permit, to ensure that the forced air ventilation is preventing the accumulation of a hazardous atmosphere.

12.2.7. Air supplying fans must remain ON and effective at all times while ventilating during PRCS entry.

12.2.8. If a hazardous atmosphere is detected before or during entry:

- The space shall be evacuated/entry prohibited.
- Ventilation shall be used to attempt to control the atmosphere.
- The atmosphere must then be tested by the Entry Supervisor to determine if ventilation is effective.
- If ventilation effectively controls the hazardous atmosphere (atmospheric levels fall to and remain within safe levels at all areas of the Confined Space), entry may be authorized by the Entry Supervisor. NOTE: ventilation must remain on and effective throughout the entry. Failure or ineffectiveness of ventilation will constitute an emergency, and all Entrants must exit the PRCS immediately.
- If ventilation is unable to control the hazardous atmosphere, entry will not be granted. A meeting to establish further entry procedures will then occur and must involve the Entry Supervisor, EHS, Entrants, Attendants, and other necessary personnel. This meeting shall determine how the hazardous atmosphere developed, what controls can be

implemented to eliminate or reduce the hazards, and what further PPE may be necessary to enter the space.

12.2.9. Local Exhaust Ventilation (negative pressure ventilation) must be used when general ventilation is not effective, or when concentrations of contaminants are generated from inside the PRCS from hazardous materials or processes (welding, painting, chemical cleaning, aerosol or adhesive use, etc.).

12.2.10. Exhaust ventilation must be positioned so that hazardous vapors and/or fume are captured by the ventilation as close to the source as possible, and not pulled through the breathing zone. General rule of thumb is to have the capture end of the exhaust ventilation no further from the source than a distance equal to half the diameter of the ventilation.

12.2.11. Exhaust ventilation must exhaust to outside open air where the exhaust cannot create a hazardous concentration of contaminants. Be careful to exhaust fume and vapors to a safe place where fume and vapor re-entry into the Confined Space is not possible. Be aware to not exhaust fume and vapor toward building air intakes.

12.2.12. Rigid and durable ventilation ducting must be used for exhaust ventilation to prevent hose collapse.

12.2.13. Ventilation equipment, used to exhaust flammable vapors, must be intrinsically safe and electrically grounded to avoid a potential spark from static build-up.

12.3. Atmospheric Testing

Testing the Confined Space atmosphere is essential for the evaluation of hazards and the verification that acceptable entry conditions exist within the Confined Space. The Confined Space must be tested for oxygen content, flammable gasses and vapors, and toxic air contaminants, in that order. A low or high oxygen reading can affect other measurements. All atmospheric testing must be conducted by the Entry Supervisor and the results must be recorded on the Entry Permit.

12.3.0. A PRCS must never be entered before conducting atmospheric testing.

12.3.1. Atmospheric testing must be conducted with air monitoring equipment that has been maintained and calibrated according to the manufacturer's specifications, and approved by EHS.

12.3.2. The air monitor used for atmospheric testing must be powered on and allowed to "warm up" in a fresh air area. A daily bump test must be completed in a fresh air area on air monitoring equipment before use.

12.3.3. Atmospheric testing of the area outside of the space must be conducted and deemed a safe atmosphere by the Entry Supervisor before opening the entry point to a Confined Space.

12.3.4. A tube, or like assembly, shall be connected to the air monitor at one end and inserted into the Confined Space's lowest/farthest dry point at the other end, to monitor the atmosphere without making entry. Allow 10 seconds for every 6 feet of tubing, or like assembly, before determining the measurements. Ensure water, dirt, debris, etc., is not taken into the tube assembly. The atmosphere within the Confined Space must be tested at three different

levels (bottom, middle and top) to ensure pockets of an IDLH atmosphere do not exist within the Confined Space.

12.3.5. The Entry Supervisor must record these results on the Entry Permit.

12.3.6. If a concentration of gas in the atmosphere is found to be outside a safe limit, appropriate ventilation must be provided. This ventilation must cause the atmosphere to remain within safe limits. TLVs, PELs, and STELs shall be used to determine a safe atmosphere. These levels can be found on the SDS of most products. If unsafe atmospheric levels still exist after ventilation controls have been implemented, authorization for Confined Space entry will not be granted. If this happens, contact EHS.

12.3.7. After the atmospheric test results show that the Confined Space is safe for entry, the Entry Supervisor shall evaluate the inside of the Confined Space further, testing for atmospheric hazards and any existing or foreseeable physical hazards. During this interior inspection, the Entry Supervisor must: bring air monitoring equipment, wear a harness, be connected from the harness to a retrieval device outside of the Confined Space when feasible, wear proper PPE, and have an Attendant in place.

12.3.8. If the monitoring equipment becomes damaged at any point, it must be taken out of service, tagged "Do Not Use" and given to EHS so it can be sent along for maintenance. If monitoring equipment becomes damaged, all Entrants must exit the space until an effective, maintained, and approved air monitoring device is in place.

12.4. Physical Hazards

12.4.0. Physical hazards that may cause serious injury must be eliminated or isolated before Confined Space entry is authorized. These hazards, and their corrective actions, shall be noted on the Confined Space Entry Permit by the Entry Supervisor. Common physical hazards can be found in Appendix A of this program.

12.5. Acceptable Entry Conditions

Conditions that must exist before Confined Space entry may be authorized are as follows:

12.5.0. An atmosphere that does not contain atmospheric hazards or has had its atmospheric hazards properly controlled so that safe atmospheric conditions exist and are maintained during entry.

12.5.1. All required employees (Attendant, Entrant, and Entry Supervisor) must be trained, present, and capable of completing their duties.

12.5.2. External rescue services (City of Pittsburgh Emergency Rescue Team) must be notified of the Confined Space entry, its location, and possible hazards.

12.5.3. The Confined Space must be removed from service and completely protected from the release of energy and materials when feasible. This shall be accomplished through isolation methods and procedures.

12.5.4. Where ventilation is required to control a hazardous atmosphere, continuous ventilation must be supplied throughout the duration of the entry.

12.5.5. Retrieval equipment such as a tripod must be in place, in good working order, and set up in a ready-to-use state.

12.5.6. A harness must be donned by the Entrant and attached to the retrieval device. If this is not feasible, the harness must be worn and the tripod must remain in a ready-to-use state.

12.5.7. Fall protection in the form of physical barricades or highly visible warnings must be in place to prevent employees and other by-standers from being exposed to a fall hazard created by the opening of a PRCS.

12.5.8. A safe and secure entry and exit point into and out of the Confined Space must exist, be secure and stable, and remain unobstructed at all times.

12.5.9. A hot work permit must be obtained for any hot work that may occur.

12.5.10. Safety Data Sheets must be made available to Entrants who will use hazardous materials in the PRCS. CMU Employees must be trained on the SDS of any chemical/hazardous material used before use.

12.5.11. A method of communication between the Entrants and Attendant must be discussed, understood, and agreed upon. This may be voice communications, radio communications, hand signals, line pull signals, or the like.

12.5.12. The Confined Space must be well lit with permanent lighting, portable lighting, or flashlights.

12.5.13. PPE such as a harness, safety glasses, hard hat, gloves, etc., must be inspected, in good condition, and donned by employees. If respirators must be used, refer to CMU's Respiratory Protection Program and follow all guidelines.

12.5.14. The Attendant must be stationed outside of the entrance.

12.5.15. An atmospheric monitor must be staged outside of the Confined Space with a tube or similar assembly that allows it to continuously monitor the atmosphere, or the atmospheric monitor must accompany the Entrants. Where hazardous atmosphere potential has been eliminated through isolation, atmospheric monitoring may occur every 30 minutes instead of continuously.

12.5.16. The Entry Supervisor must list all hazards, and the corrective actions required to control those hazards, on the Entry Permit. All corrective actions must be in place.

12.5.17. The Entry Supervisor must ensure the Entry Permit is complete and must sign the Entry Permit to authorize entry. The permit must be available on site.

12.5.18. A pre-entry briefing by the Entry Supervisor must be conducted with all other Entrants and Attendants.

12.6. Entry

12.6.0. When all pre-entry requirements of this program have been satisfied, entry may be authorized.

12.6.1. Authorized Entrants and Attendant must communicate regularly to ensure safe conditions and permit requirements are maintained.

12.6.2. The Attendant must remain stationed outside the entrance throughout the entry, unless relieved by another authorized Attendant. The Attendant is prohibited from performing other duties that may distract them from their primary duty of monitoring the Entrants.

12.6.3. Attendant must record results of atmospheric monitoring, at least every 30 minutes, on the Entry Permit.

12.6.4. Entrants may not introduce or create any new unplanned hazards into the Confined Space. If new hazards would arise from a needed change in operations, the Confined Space must be vacated and reevaluated by the Entry Supervisor.

12.7. Exit and Emergency Rescue

12.7.0. Entrants must alert the Attendant of an emergency situation when:

- A condition prohibited by the permit arises.
- An Entrant recognizes a warning sign or symptom of exposure to a dangerous situation.
- A hazardous or IDLH atmosphere is detected.

12.7.1. Entrants must exit from the space as quickly as possible when:

- An order to evacuate is given by the Attendant or Entry Supervisor.
- An Entrant recognizes any warning sign or symptom of exposure to a dangerous situation.
- A condition prohibited by the permit is detected.
- A hazardous or IDLH atmosphere is detected.
- An evacuation alarm, or atmospheric monitor alarm, is activated.

12.7.2. The Attendant must order the Entrants to evacuate the space immediately if any of the following conditions are recognized:

- A condition prohibited by the Entry Permit arises.
- A behavioral effect of a hazard exposure is recognized.
- A hazardous or IDLH atmosphere is detected.
- The Attendant detects a situation outside the space that could endanger the Entrants.
- The Attendant cannot effectively and safely perform their duties.

12.7.3. If at any point an Authorized Entrant or Attendant feels that work is unsafe, notices symptoms or signs of exposure, or feels physically or mentally incapable of their duties, all Entrants will be notified and must exit the space immediately.

12.7.4. The Attendant must notify UNVERSITY POLICE by calling 412-268-2323 as soon as it is noticed that Entrants will require assistance to exit the space.

12.7.5. Information given to UNVERSITY POLICE must include that this is a Confined Space entry, the location of the space, the number of Entrants in the space, and the hazards. UNVERSITY POLICE has been trained to notify external rescue services in the event of a Confined Space incident.

12.7.6. If an IDLH atmosphere is detected during entry and/or occupancy, all personnel will evacuate the space immediately, without question, regardless of job activities. EHS must be contacted and an investigation will be conducted to determine how the hazardous atmosphere developed. The Confined Space will be secured, and re-entry prohibited, until an investigation occurs and corrective actions are identified.\

12.8. Entry Completion/Closeout

12.8.0. Upon completion of the work within the Confined Space, the space will be cleared of personnel, equipment, tools, trash, hazardous materials, hazardous waste, etc., and the entrance cover or door replaced in its original position/condition. The Entry Permit(s) will be closed and filed with the EHS Office. All permits and air monitoring equipment must be returned to EHS within 24 hours of work completion.

13. Emergency Response and Rescue

13.1. Confined space rescue shall be attempted and performed in this order: self-rescue, Attendant non-entry rescue, and rescue by external rescue services. This order lists rescue options from the most time-effective to the most resource intensive. In most cases, the priority of Confined Space rescue is removing Entrants from the Confined Space as quickly as possible.

13.2. Self-Rescue

13.2.0. The best rescue option is self-rescue. Self-rescue occurs when the Entrant recognizes his or her own signs/symptoms of exposure, is alerted of signs/symptoms of exposure by the Attendant or other Entrants, or is injured/starts to feel ill, and immediately exits the Confined Space under their own power.

13.2.1. If any warning signs or symptoms of exposure to a hazardous situation are detected, or an injury/illness occurs in a Confined Space:

- All Entrants must perform self-rescue and exit the space immediately.
- Other Entrants shall assist the ill or injured person(s), and all Entrants shall exit the Confined Space immediately. The Attendant must not enter the Confined Space to assist with rescue.
- Attendant must contact University Police and request medical assistance if needed.
- Attendant shall contact immediate supervisor and EHS to notify them of the incident.
- Attendants and Entrants shall remain outside of the Confined Space, and out of harm's way, until the hazard is identified, evaluated, and eliminated. DO NOT RE-ENTER THE SPACE.
- University Police shall secure the scene and give medical assistance if trained to do so.
- Student EMS shall evaluate and treat the injured or ill patient if necessary.
- City EMS will control the scene and treat the patient upon their arrival.

13.3. Attendant Non-Entry Rescue

13.3.0. **No CMU employee should enter a Confined Space to attempt a rescue.**

13.3.1. The Attendant shall notify University Police as soon as it is noticed that an Entrant will require assistance to escape from the Confined Space.

13.3.2. If self-rescue is not an option, ineffective, or unable to be performed by the Entrant, the Attendant must perform non-entry rescue.

13.3.3. The Attendant will perform non-entry rescue by using the retrieval device to extract the Entrant from the Confined Space.

13.3.4. When attachment of an Entrant's harness to a retrieval device is feasible, this must be done for the duration of the entry. In these instances, the Attendant can perform non-entry rescue using the retrieval device to remove the Entrant from the Confined Space.

13.3.5. Where it is infeasible for the harness and retrieval device to be connected, the Attendant will summon external rescue services to perform rescue; contact University Police by calling 412-268-2323 to do this.

13.3.6. Retrieval equipment or methods must meet the following requirements:

- Each Authorized Entrant must wear a full body safety harness for the duration of entries more than five feet in depth.
- The Entrant's full body harness must be attached to a mechanical device with a retrieval line when feasible.
- Retrieval lines must be attached to a mechanical device (hoist) or a fixed point outside of the space prior to entry. The hoist must be ready to use for emergency situations prior to entering the Confined Space.
- For horizontal entrances, at a minimum, a rope or other means must be attached to the harness so that the Entrant can be pulled out in an emergency situation.

13.3.7. Once the affected Entrant has been rescued from the Confined Space:

- Other Entrants and Attendant can give medical assistance if trained to do so.
- Attendant shall notify immediate supervisor and EHS.
- University Police shall secure the scene and give medical assistance if trained to do so.
- Student EMS shall evaluate and treat the injured or ill patient if necessary.
- City EMS will control the scene and treat the patient upon their arrival.

13.4. Rescue Performed by External Rescue Services

13.4.0. When self-rescue and non-entry Attendant rescue are not an option, ineffective, or unable to be performed, the Attendant must summon external rescue services.

13.4.1. To summon external rescue services, **CONTACT University Police** by calling **412-268-2323.** University Police will notify external rescue services. This information will be reiterated on the Entry Permit.

13.4.2. CMU will rely on external rescue services, currently the City of Pittsburgh EMS Rescue Team, in the event of an emergency during a Confined Space entry where self-rescue and non-entry rescue is ineffective or unable to be performed. It is preferred by the City of Pittsburgh that every Confined Space Entrant wear a harness. A retrieval device must be maintained just outside of the entrance into the Confined Space and kept in a manner that it can be quickly utilized by external rescue services if needed.

13.4.3. University Police will secure the scene and assist with crowd and traffic control during an emergency situation.

13.4.4. Once at the scene, external rescue services will take control of the incident until the victim(s) has exited the space.

13.4.5. Student EMS may assist external rescue services if needed, after the Entrant has been rescued from the space.

13.4.6. If an injured Entrant was exposed to a substance for which a safety data sheet (SDS), or other similar written information, exists, that written information shall be made available to the medical facility treating the exposed Entrant.

14. Non-Permit Required Confined Spaces

14.1. Non-Permit Required Confined Spaces: A Confined Space can only be classified as a non-permit required Confined Space by EHS. These Confined Spaces do not require a permit and do not have, or have the potential to contain, any hazards capable of causing death or serious physical harm. Non-permit required Confined Spaces do not require specific controls for entry unless being reclassified from a PRCS.

14.1.0. Non-permit required Confined Spaces may not be worked in alone.

14.1.1. Requirements for reclassifying a PRCS to a non-permit required Confined Space can be found in Section 16 of this program.

14.1.2. At no time, while working within a non-permit required Confined Space, may a new hazard be introduced so that the Confined Space can no longer be classified as a non-permit required Confined Space. This may include, but not be limited to, conducting hot work, creating welding or cutting fume, using paints, spray adhesives, solvents, hazardous materials, chemicals, etc.

15. Confined Space Entry Equipment

The following safety equipment may be needed for safe entry and egress from Confined Spaces:

15.1. Atmospheric testing equipment and tubing.
15.2. Ventilation equipment to obtain and maintain acceptable atmospheric conditions.
15.3. Harness. Harnesses must be worn by Confined Space Entrants. If infeasible, harnesses do not need to be connected to tripods for the duration of the entry.
15.4. Retrieval device such as a tripod. If it is infeasible for the Entrant to remain connected to the retrieval device, then the retrieval device must be maintained just outside of the entrance into the Confined Space and kept in a ready-to-use state so that it may be quickly utilized by Pittsburgh EMS Rescue Teams if needed.
15.5. Barriers and shields used to protect an uncovered hole or unguarded edge created by opening the Confined Space. Fall protection may also be needed inside of the Confined Space if an uncovered hole or unguarded edge exists within.
15.6. Communication equipment such as two-way radios or cell phones.
15.7. All necessary PPE. This may include respiratory protection and filters, gloves, boots, hard hat, Tyvek suit, etc.
15.8. Lighting equipment and flashlights.
15.9. Lockout/Tagout devices and documentation.
15.10. Phones to contact UNVERSITY POLICE in case of an emergency.
15.11. Rope, webbing, or tape.
15.12. Ladders or scaffolding.
15.13. All equipment required for Confined Space entry must be maintained according to the manufacturer's recommendations.

16. Reclassifying A Confined Space

16.1. A PRCS may be reclassified to a non-permit required Confined Space under the following conditions:

16.1.0. The PRCS poses no actual or potential atmospheric hazards, and all other hazards within the space are eliminated without entry into the space. The permit space may be reclassified to a non-permit required Confined Space as long as all hazards remain eliminated.

16.1.1. If it is necessary to enter a PRCS to eliminate hazards, entry will be performed as a PRCS entry. Testing and inspection must demonstrate that the hazards have been eliminated by the implemented hazard controls. Then, the permit space may be reclassified to a non-permit required space for as long as the hazards remain eliminated.

16.2. To reclassify a PRCS into a non-permit required Confined Space, contact EHS.

16.3. Follow the requirements specific to the Confined Space for reclassifying the space from a PRCS to a non-permit required Confined Space. These requirements shall be provided by EHS.

16.4. Once reclassification requirements have been completed, EHS will authorize the reclassification. The space may remain reclassified and entered as a non-permit required Confined Space as long as hazards remain eliminated.

16.5. If a hazardous situation arises while working in a Confined Space that has been reclassified to a non-permit required Confined Space, each person in that space will exit the space immediately and the space will be re-evaluated by EHS. The reevaluation will attempt to determine the cause of the hazardous situation, and if necessary, identify new requirements needed to reclassify the space.

16.6. Elevator shaft pits whose only hazard is the elevator itself, will be considered non-permit required Confined Spaces as long as proper lockout/tagout procedures have been implemented and new hazards are not introduced into the space.

17. Emergency Entrance into a Confined Space

17.1. If a Confined Space requires emergency entry, and that space meets the definition of a PRCS, then entry procedures described in this program must be followed before entry. Emergency entry into a Confined Space prior to atmospheric monitoring is prohibited.

17.2. EHS personnel can be contacted 24/7 through the EHS emergency hot line. That phone number is 412-268-8182.

18. Identification or Creation of a New Confined Space

18.1. When a new Confined Space is identified or created, EHS must be notified. This can be done by emailing safety@andrew.cmu.edu with details about the location and configuration of the space.

18.2. Upon identification or creation of a new Confined Space, EHS shall be responsible for classifying, labeling, and documenting the Confined Space and its associated hazards. This information shall be added to the Confined Space inventory list.

Appendix A – Common Confined Space Hazards

Confined Space Hazards

Confined spaces are unique and pose hazards that are uncommon in typical work areas or conditions. Because Confined Spaces can contain such unique hazards, it is important for each Authorized Entrant, Attendant, and Entry Supervisor to understand these hazards and the best practices to eliminate them.

Atmospheric Hazards

Atmospheric hazards are hazards that exist, or can be created, in the atmosphere inside of a Confined Space. Atmospheric hazards exist more commonly, and in higher concentrations, in Confined Spaces due to the lack of natural ventilation in these areas. Entrants are mostly affected by atmospheric hazards through breathing and inhalation. Atmospheric hazards are usually invisible and may contain no smell or odor.

Oxygen- Oxygen levels inside of Confined Spaces can vary due to many different causes. An oxygen level below 19.5% is considered deficient and does not contain enough oxygen to support prolonged human life. An oxygen level above 23.5% is considered enriched and can be an explosion or fire hazard. A decrease in oxygen inside of a Confined Space can be the result of: hot work and welding, over accumulation of rust, vegetation/organic material decay, or the space filling with an inert gas that pushes oxygen out of the area. Respirators will not help in oxygen deficient atmospheres as they do not themselves provide oxygen. An elevated level of oxygen is usually the result of a leaking oxygen line, hose, or pipe. Isolation or removal of leaking lines/pipes and should be used to reduce an oxygen enriched atmosphere. Adding fresh air to the space through mechanical ventilation can lower oxygen levels back to normal.

Volatile Organic Compounds- VOCs are chemicals that easily produce gasses or vapors that can be acutely toxic, or have long term health effects, at certain concentrations. VOCs are released by: burning, welding, chemicals use, treated surfaces, fuels and surfaces of areas that previously contained fuel, aerosol sprays, paints, glues, adhesives, cleaners, degreasers, and solvents. Acceptable levels of VOCs vary based on the source of the VOCs; acceptable levels can be found on the source's Safety Data Sheet (SDS). Ventilation should be used to remove these gasses and vapors from a Confined Space before entering. A respirator with organic vapor cartridges can also be worn to protect against exposure to VOCs.

Carbon Monoxide- CO is a colorless odorless gas that is created by the incomplete combustion of carbon. Exposure to carbon monoxide prevents the body from absorbing oxygen and can be lethal. CO is heavier than air and will typically settle at the lowest point in an area. CO

accumulation in a Confined Space can be caused from hot work or fuel powered equipment running inside of a Confined Space. It can also be caused by fuel powered equipment, such as a tool, generator, or vehicle, running outside of a Confined Space, where the entry point of the Confined Space is lower than the equipment. In this instance, the CO will travel from the equipment exhaust and into the Confined Space due to the weight of CO causing it to settle at the lowest point. Attendants should ensure that equipment and vehicles do not run near the entrance of the space. Ventilation should be used to ensure CO is removed from a Confined Space before entering.

Hydrogen Sulfide- H2S, sometimes known as sewer gas, is caused by the decay of organic matter such as sewage, sludge, or vegetation. H2S is a colorless gas with a distinct rotten egg smell. H2S is corrosive, flammable, and extremely toxic. Caution must be used when conducting work in Confined Spaces that contain drainage systems or sewage piping. Ventilation must be used when any potential exists for the accumulation of H2S.

Flammable and Explosive Atmospheres- Due to the lack of air flow and natural ventilation inside of Confined Spaces, flammable atmospheres can develop quickly when using certain products. Typically, products that produce flammable gasses and vapors include: fuels, paints, adhesives, solvents, degreasers, acetylene, and other welding/flammable gasses. Always read the (SDS) of a product before using it in a Confined Space. The above products will almost always require ventilation when used in a Confined Space, according to the SDS. Combustible dusts can also cause an explosive atmosphere, and accumulate quickly, in a Confined Space. Ensure that hot work operations and other sources of open flames are kept away from areas that may contain a combustible dust environment. Avoid large amounts of wood cutting inside of a Confined Space to prevent the accumulation of combustible dusts.

Physical Hazards

Physical hazards have the potential to cause serious injury or death through different sources of energy. Physical hazards are usually more common and easier to identify than atmospheric hazards but can be equally or more dangerous.

Fall Hazards- Many Confined Spaces are also accompanied by fall hazards. Confined spaces that have an entry point at ground level, such as manholes, create a fall hazard when opened. Other Confined Spaces may contain fall hazards inside of the space such as: unguarded edges over 4 feet above the surface below, walkways or catwalks without railings, or holes in the floor that are uncovered. Cords, cables, and lines can also cause fall/trip hazards in limited space areas like Confined Spaces. The best solutions for protection against fall hazards are to install mobile/temporary railings around ground level entry points, install guardrails or chains at

unguarded edges, and cover holes with a material able to support the highest expected load, such as ¾ inch plywood or a metal plate. Also, ensure all cords, cables, and lines are organized and kept overhead and off the floor, or properly covered, to prevent trips.

Stuck-by and Caught Between Hazards- Confined spaces often house equipment that must be accessed, maintained, repaired, or replaced. Equipment that utilizes moving parts and nip points, such as gears, drives, belts, arms, or pistons, can cause serious injury. Locking out any moving equipment that the Confined Space Entrant must interact with is the best solution to preventing these hazards.

Electrocution and Shock- When electricity causes an injury it is referred to as electrical shock. When an electrical injury results in a death, it is considered an electrocution. Confined spaces often contain electrical equipment. They either contain permanent electrical lines and equipment, or power is provided to the Confined Space through the use of portable power and extension cords. To protect against electrical hazards, lockout should be performed to eliminate electrical energy when working on equipment. When using extension cords and portable power, inspect equipment before each shift and remove any damaged electrical equipment from service. Ensure to prevent damage to electrical equipment during use by leaving all parts/safeguards on the equipment, and by preventing the equipment's exposure to pinch points or sharp edges. Ensure electrical equipment stays separated from water and wet areas.

Engulfment or Entrapment – Becoming engulfed by a substance, or entrapped in a Confined Space, can be lethal. Some common engulfment hazards include: water, loose soil or earth, grain, and any other liquid or flow able solid that can capture a person and prevent effective breathing. Entrapment occurs when an entrant is trapped or asphyxiated by a space that contains inwardly converging walls, or a floor that slopes downward to a smaller cross section. Removing an engulfment substance from a Confined Space before entry is the most effective way to prevent engulfment. Fall prevention techniques can also be used to ensure entrants are not exposed to an engulfment material or entrapped in a Confined Space.

Fire – Confined spaces are often difficult to enter and exit and may require more time to evacuate in the event of an emergency. Fires that occur in Confined Spaces can be difficult to escape, due to the restrictive configuration, or number, of exits. Preventing the accumulation of combustible material and adhering to all requirements of CMU's hot work permit is an effective way to prevent fires in a Confined Space. Keeping Confined Space entrances and exits, as well as their routes, open and clear of debris and obstructions will aid in escape in the case of a fire.

Health Hazards- Health hazards are hazards related to the Confined Space Entrant's physical and mental health. Health hazards can occur in many different environments, but extraction from a

Confined Space can be difficult and timely, delaying the response of medical services. Many strategies can be taken to ensure health hazards do not affect Confined Space Entrants. These include:

- Wearing appropriate PPE such as a respirator, hard hat, safety glasses, gloves, etc.
- Taking breaks in cooled or shaded areas as often as necessary to prevent over-heating in hot environments.
- Drink cold water to cool the body temperature. Avoid hot drinks such as hot coffee or hot tea. Hydrate with water the night before when possible.
- Provide fresh air ventilation to hot areas to reduce space temperatures.
- Dress in warm and dry clothes when working in cold environments.
- **Know your limits. If you do not feel well, exit the space immediately and let your supervisor know.**

Appendix B – Confined Space Entry Permit

Confined Space Permit

Permit valid until end of shift

Carnegie Mellon University
Environmental Health & Safety
FIRE | LAB | WORK

Confined Space Location:	**Entry Date and Work Order Number:**
Reason for Entry:	**Authorized Entrants and Attendants:**

Results of Entry Supervisor Test and Inspection

Note: Entry Supervisor Inspection must include air sampling and an assessment of the intended work area so all hazards are identified.

Date	Time	O_2%	LEL%	H_2S PPM	CO PPM	VOC PPM	Instructions or Hazards that Require Abatement	Entry Supervisor Initials

Results of Continuous Monitoring

Date	Time	O_2%	LEL%	H_2S PPM	CO PPM	VOC PPM	Notes	Attendant Initials

OSHA Parameters: **Oxygen** 19.5% - 23.5%, **LEL** <10% ACGIH Identified Toxins: **CO** <25 ppm, **H_2S** <5 ppm

In an emergency: Dial **412-268-2323** to reach CMU University Police. Describe the **situation, location, hazards, and Confined Space.**

Results of Continuous Monitoring

Date	Time	O_2%	LEL%	H_2S PPM	CO PPM	VOC PPM	Notes	Attendant Initials

OSHA Parameters: **Oxygen** 19.5% - 23.5%, **LEL** <10% ACGIH Identified Toxins: **CO** <25 ppm, **H_2S** <5 ppm

In an emergency: Dial **412-268-2323** to reach CMU University Police. Describe the **situation, location, hazards, and Confined Space.**

Completed forms must be provided to the EHS office for recordkeeping purposes. **Reminder: Ventilation and Firewatch required for all hot work.**

Entry Supervisor **Printed Name** and **Signature** (Authorizing Entry):_____