University of Pennsylvania

Confined Space Program Main Campus

Environmental Health & Radiation Safety
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Contents

1. PURPOSE

The purpose of this program is to protect University of Pennsylvania (Penn) workers against the hazards involved in confined spaces. Further, this procedure establishes the controls and responsibilities for entering, working in, and exiting confined spaces while complying with OSHA CFR 1910.146.

2. SCOPE

This program covers all Penn employees on the main campus who are required to enter confined spaces such as manholes, ducts, tanks, etc., which may potentially contain hazardous atmospheres and/or conditions. The Morris Arboretum and New Bolton Center Campuses are covered under their own programs.

3. DEFINITIONS

Acceptable Entry Conditions – the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter and work within the space.

Attendant - a Qualified Employee stationed outside of the Permit-Required Confined Space who monitors the authorized entrant(s).

Confined Space - a space which:

- Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit (some examples are tanks, boilers, manholes); and
- Is not designed for continuous employee occupancy.

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.

Entrant or Authorized Entrant - a Qualified Employee or contractor who will enter the Confined Space. The entrant is trained on the procedures of the Confined Space Entry Procedures and is authorized by Penn to enter.

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

Entry Permit - a written authorization to enter a Permit-Required Confined Space. It defines the conditions under which the permit space may be entered. It states the reasons for entering, identifies all hazards and identifies the Entry Supervisor.

Entry Supervisor - a Qualified Employee who is responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, authorizes entry (Does this mean that Penn will have a Penn person on all contractor entries?), oversees entry operations, and terminates entry when required.

Hazardous Atmosphere: An atmosphere that may expose employees to the risk of death, incapacitation, interfere with an individual's ability to escape unaided from a space, or cause acute illness from one or more of the following causes:

- Flammable gas, vapors, or mists in excess of five percent (5%) of its Lower Explosion Limit (LEL).
- Airborne combustible dust at a concentration that meets or exceeds its Lower Flammable Limit (LFL).
- Atmospheric oxygen concentrations below 19.5% or above 23.5%.
- Atmospheric concentrations of any substance that could meet or exceed the permissible exposure limit as prescribed by OSHA standards. Review the MSDS sheets of all known substances contained within a space.
- Any other atmospheric condition that is immediately dangerous to life or health (IDLH).

Immediately Dangerous to Life or Health – any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

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

Non-Permit Confined Space - a Confined Space which does not contain or have the potential to contain a "Hazardous Atmosphere" or any hazard capable of causing death or serious physical harm.

Permit Required Confined Space (PRCS):

A Confined Space that has one or more of the following characteristics:

- Contains or has the potential to contain a "Hazardous Atmosphere"
- Contains a material with the potential for engulfment of an entrant,
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor which slopes downward and tapers to a smaller cross-section; or
- Contains any other recognized serious safety or health hazard.

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

Qualified Employee - an employee that has been trained on confined space entry procedures and the use of confined space equipment, air-monitoring equipment, and ventilation equipment.

Rescue Services – Penn uses the **Philadelphia Fire Department** as their rescue service.

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

Stratified Atmosphere - an atmosphere where the contents have become "layered". Atmospheric testing may indicate different percentages of oxygen, explosive gasses, and hazardous contaminants at different levels.

Testing – the evaluation of the hazards of the permit space and verification that acceptable conditions exist for entry into that space.

4. RESPONSIBILITIES

A) Executive Director of EHRS and Designees:

The Executive Director of Environmental Health and Radiation Safety (EHRS) is responsible for the development, implementation, coordination of training, and administration of the Confined Space Program.

B) Supervisors:

1) Are responsible for initiating and controlling this procedure on shift.
2) Ensure that the proper procedures for isolating all energy sources are followed and that all energy sources have been controlled.
3) Ensure Entry Supervisors are inspecting work in spaces to ensure adherence to the procedures.
4) Train employees for confined space operations.

C) Entry Supervisors

1) Be trained to be aware of the hazards of the space to be entered, and the signs, symptoms and consequences of exposure and specific space control procedures.
2) Execute all requirements of this instruction before work begins within a confined space.
3) Authorize entry into a confined space when acceptable entry conditions have been met.

4) Ensure that all personnel entering and leaving the confined space are accounted for.

5) The Entry Supervisor shall terminate the entry and cancel the entry permit when:

   a) The entry operations covered by the entry permit have been completed or

   b) A condition that is not allowed under the entry permit arises in or near the permit space.

6) Verify that rescue services have been identified and that means for summoning them are operable.

7) Prohibit unauthorized individuals from entering the permit space during entry operations.

D) Entrants

1) Be trained to know the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of an exposure.

2) Use all equipment as required by this instruction and the specific permit space entry procedures.

3) Communicate with the attendant as necessary to enable the attendant to alert entrants of the need to evacuate the space as required by this instruction and for the attendant to be able to monitor the status of entrants.

4) Alert the attendant whenever:
   a) The entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, or
   b) The entrant detects a prohibited condition.
   c) Exit from the confined space as quickly as possible whenever:
      (i) Order to evacuate is given by the attendant or the entry supervisor
      (ii) The entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, or the entrant detects a prohibited condition, or an evacuation alarm is activated.

E) Attendants

1) Be trained to know the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure.

2) Be aware of the possible behavioral effects of hazardous exposure in authorized entrants.

3) Continuously maintain an accurate count of authorized entrants in the permit space and ensure that the mean used to identify authorized entrants in the permit under this procedure is accurate.

4) Remain outside the permit space during entry operations until relieved by another attendant. Attendants shall never monitor more than one confined space.

5) Communicate with authorized entrants as necessary to monitor entrant(s) status and to alert entrant(s) of the need to evacuate the space if conditions warrant.

6) Initiate onsite rescue procedures and if necessary, summon additional rescue and other emergency rescue services when self-rescue is not possible.
7) Perform no duties that might interfere with his/her ability to monitor and protect the authorized entrants.
8) Monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space.
9) Warn unauthorized persons to stay away and advise those who may have entered the permit space that they must leave.
10) Inform unauthorized entrants and entry supervisor of unauthorized persons.

5. CONFINED SPACE ENTRY PERMIT

Before entry is authorized, the entry supervisor shall document the safety measures taken in order to enter the Permit Required Confined Space (PRCS) by preparing a Confined Space Entry Permit (Appendix D).

Before entry begins, the entry supervisor identified on the permit shall complete and sign the entry permit to authorize entry. Acceptable entry conditions must be met in order for entry to be authorized.

The completed permit shall be made available at the time of entry to all authorized entrants, by posting it at the entry portal or by any other equally effective means; so that the entrants can confirm that the pre-entry preparations have been completed.

The duration of the permit may not exceed the time required to complete the assigned task, the job identified on the permit or one work shift.

The entry supervisor shall terminate entry and cancel the entry permit when:

- The entry operations covered by the entry permit have been completed or
- A condition that is not allowed under the entry permit arises in or near the permit space

All canceled and completed entry permits shall be retained by FRES for one year to facilitate the review of the PRCS program. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the program can be made.

5. ATMOSPHERIC TESTING

Atmospheric testing is required to ensure that acceptable conditions for entry into that space exist. The level of testing required for normal entry operations will be documented on the specific Confined Space Procedures and entry permit.

Testing Equipment

The confined space meter used to monitor the space must be a multi-gas monitor which is configured to monitor for Combustible Gases (LEL), Oxygen, Carbon Monoxide and Hydrogen Sulfide. Only personnel trained and certified on the proper use and application of the monitoring equipment will be permitted to utilize the equipment when conducting atmospheric testing. UPenn FRES utilizes the MultiRAE Lite Meters which are stored in the Left Bank Steam Shop Office and one on the Steam Shop Facility Vehicle.

MultiRae Lite Meter

Preparation of Testing Equipment

Bump Tests (or "functional test") checks for sensor and alarm functionality. The installed sensors are briefly exposed to expected concentrations of calibration gases that are greater than the sensors' low alarm set points. When one or more sensors "pass" the test, they are "functional" and the unit will alarm. Each sensor's "pass" or "fail" result is indicated on the unit's display. A Bump test must be completed prior to using the equipment.

Meter Calibration must be completed upon initial use and every 4 months thereafter according to the manufacturer's instructions. Penn EHRS will perform the calibration and perform or coordinate any maintenance or repairs to the equipment. Calibrations must be documented, and that documentation includes a calibration sticker on the meter and updates to the calibration spreadsheet which can be found on the EHRS T:drive.

Testing the Confined Space

Prior to atmospheric testing, check air readings outside of the confined space to ensure proper operation of the meter and that air readings are within normal ranges. Record those readings on the Entry Permit.

Air testing for Confined Spaces having a top entrance (manholes, tanks, etc.):

- From each entrance, drop the sampling probe of the Meter to the bottom of the space.

Additionally, use other available openings, which would facilitate air testing for that confined space.

- Slowly raise the sampling probe, stopping at intervals of two feet to ensure that the atmosphere is not stratified. The rate of sampling shall be slowed to accommodate detector response due to the length of the sampling line and probe.
- Record air testing data on the confined space permit.
- The Entry Supervisor shall review Air Testing results with both the Attendant and the Entrants before entry is made.

Air testing for Confined Spaces having a side or bottom manway (ducts, tanks, etc.):

- From each entrance, move the sampling probe of the Meter to the opposite side of the space. Use rods, poles or other means to extend the probe to the opposite side of the space.
- Slowly test all areas inside the Confined Space. The rate of sampling shall be slowed to accommodate detector response due to the length of the sampling line and probe.
- Record air testing data on the confined space permit.
- The Entry Supervisor shall review Air Testing results with both the Attendant and the Entrants before entry is made.

If there are no non-atmospheric hazards present and if the pre-entry tests show there are no dangerous air contamination and/or oxygen deficiency within the space, entry into and work within the space may proceed.

The atmosphere within the space shall be continuously tested to ensure no accumulation of a hazardous atmosphere. Air monitoring shall be performed at the actual work location in the confined space. The results of this monitoring shall be documented on the confined space permit, at a frequency established by the Entry Supervisor. Employees will be provided the opportunity to observe the air monitoring of a space.

The workers will immediately leave the permit space and notify their supervisor and EHRS @ (215) 898-4453, when any of the gas monitor's alarm set points are reached as defined. After a suitable ventilating period, repeat the testing. Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated and EHRS approves.

Re-testing should be completed prior to re-entry after breaks or whenever the space is left unattended, or evaluations indicate that conditions in the space have changed

6. ENTRY PROCEDURES

Prior to entry into a confined space, The Entry Supervisor will conduct a job review to discuss the safe entry procedures with the personnel involved. The required equipment will be assembled, and instructions will be conveyed to those involved in the entry; procedures will be discussed; and hazards, which may be encountered, will be explained. The Confined Space Hazard Evaluation contained in Attachment A must be reviewed and the acceptable entry conditions must be met in order for entry to be authorized:
Specifying acceptable entry conditions,

- Isolating the permit space,
- Purging, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards,
- Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards and
- Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

7. RESCUE PROCEDURES

Retrieval and rescue equipment is required for entry into permit required confined spaces. The use of a full body harness is not required if it will create a greater hazard to the wearer.

In the event of an emergency of any type in the confined space, entrants in the space shall evacuate as quickly as possible. Injured employees are encouraged to use self-rescue when applicable

If rescue from within the confined space is required, the attendant should immediately call **PennCOM, (215) 573-3333 or 911 from a cell phone.** Inform the PennCOM Operator that rescue is needed from a confined space. Give PennCOM the location, the type of confined space, and the hazards associated with the space. After a rescue response confirmed, the Attendant shall notify their Supervisor and EHRS.

Under no circumstances will a Confined Space Attendant enter a confined space during rescue. Their responsibility is to ensure that the rescue team arrives at the correct location and receives all information regarding the confined space and the circumstances surrounding the need for rescue.

8. HEAT HAZARD ASSESSMENT AND ABATEMENT PROCEDURES

It is the intent of Penn to isolate confined space steam hazards using the double block and bleed method, whenever available. When double block and bleed is not available, the supervisor shall discuss means to abate the hazards associated with the work with EHRS to determine the method of isolation for the confined space.

Prior to entry into a Steam Manhole, the Entry Supervisor shall conduct a Heat Hazard Assessment to determine the heat hazards present or likely to become present during the work activity. Results of the assessment and methods to abate shall be recorded on the Confined Space Entry Permit (Appendix D).

The following procedure shall be followed to assess the hazards associated with heat and heat stress in manholes:
Assessment of heat conditions using Penn provided equipment:

- Pit Temperature
- Ambient Temperature

In order to establish acceptable conditions for entry, the following hazards and methods to abate these hazards shall be determined and recorded on the Confined Space Entry Permit:

Heat Stress: Guidelines for Work in Hot Environments

- Use of Ventilation
- Training of employees on recognizing symptoms of heat stress
- Cool beverages available
- Establish time limitations in the confined space based on acclimatization

Exposed Steam Pipes:

- Method of isolation and cool-down of pipes
- Use of insulating blankets or other barrier devices
- Other means to abate

Steam Leaks

- Method of isolation
- Use of barrier devices
- Other means to abate

9. RECLASSIFYING A PERMIT REQUIRED CONDINED SPACE

A space classified as a PRCS may be reclassified as a non-permit confined space under the following procedures.

If the PRCS poses no actual or potential atmospheric hazards or if all hazards within the space are eliminated without entry into the space and without the use of forced ventilation, the permit space may be reclassified as a Non-Permit Confined Space for as long as the non-atmospheric hazards remain eliminated.

If it is necessary to enter a PRCS to eliminate the hazard or to test for atmospheric hazards, such entry shall be completed under a confined space permit.

Once the space is reclassified, it may be treated as a Non-Permit Confined Space for the duration of the work being performed. The permit is no longer required as well as the attendant, supervisor, retrieval and rescue equipment. Air monitoring should be conducted each day before entering the non-permitted space. Once a job is complete, the space reverts to a PRCS.

The Entry Supervisor is responsible for documenting the basis for determining that all hazards in the permit space have been eliminated through a certification that contains the date, the location of the space, any air sampling data to support this and the signature of the Entry Supervisor making the determination (the use of a confined space entry permit will meet this requirement). The Supervisor will sign on the permit that the space has been reclassified as a Non-Permit Confined Space. This certification shall be made available to all employees involved.

10. CONTRACTORS

At a minimum, Contractors must follow the requirements of OSHA's Confined Space requirements. Penn will provide Contractors information on all PRCS to be entered, and the potential hazards associated with the Confined Space.

Contractor employees must be trained in confined space entry. Contractors that are required to enter a Confined Space must attest that their employees have been trained in accordance with 29 CFR 1910.146.

Penn's Contractor Representative will communicate to the Contractor, the requirements of this program and potential hazards they may encounter inside the confined space and the surrounding area. Contractor Training should be documented.

Penn will coordinate efforts anytime an employee and a Contractor(s) employee(s) are simultaneously entering a space. If multiple contractors/employees are going to be occupying the same area, the following shall take place:

- A pre-job briefing shall be conducted involving all pertinent work groups. This briefing shall include the requirement of a separate air monitoring and permitting for each contractor, means to prohibit unauthorized/accidental entry, known hazards associated with the space, means to abate those hazards, and procedures for emergency response.
- A review of Penn's Lock-out/Tag-out Program and requirements for its use.
- Identification of all Entry Supervisors, Attendants, and Entrants.
- Means of communication between work groups, including signaling for evacuation.
- A collective debriefing between all work groups at the closing of each permit day.

11. TRAINING

All personnel involved with confined space activities shall receive training consistent with their duties. Employees will receive training in order to acquire the understanding, knowledge and skills necessary for the safe performance of the duties assigned under this program.

Training shall be provided to each affected employee that may be designated as a supervisor, entrant or attendant:

- Before the employee is first assigned duties,
- Before there is a change in assigned duties,
- Whenever there is a change in confined space operations which presents a hazard to an employee who has not been previously trained and
- Whenever the employer has reason to believe that there are deviations from the confined space entry procedures or that there are inadequacies in the employee's knowledge or use of these procedures.
- The training shall establish employee proficiency in the duties required and shall introduce new or revised procedures, as necessary for compliance.

Training content shall include:

- Requirements of 29 CFR 1910.146-Permit-Required Confined Spaces for work covered under General Industry and 29 CFR 1926.1200 Subpart AA for construction work.
- Overview of Penn's Main Campus Confined Space Program and other procedures relating to confined space entry (lockout tagout, hot work, etc.).
- General Rules including hazards associated with confined spaces.
- Responsibilities of management/supervision, entrants, attendants, and supervisors.
- Procedures – guarding of openings, air testing /air testing equipment and use of ventilation equipment and personal protective/entry equipment
- Emergency action & rescue procedures.

12. DOCUMENTATION

Penn shall retain each canceled entry permit for at least one year to facilitate the review of the PRCS program. EHRS will conduct and document this review. One single annual review of the Confined Space Entry Program shall be conducted covering all entries from the previous 12 months. This review shall be

conducted to evaluate the effectiveness of the program, identify changes in the work environment that will affect future permits, and ascertain the need for changes in procedure. If there has been no entry in the previous 12 months, no review is necessary; however, documentation shall be completed to certify this non-entry status.

Training documentation shall be kept for all affected employees. Training rosters shall indicate the employee's name, date, level of training (supervisor, entrant, and/or attendant) and the instructor who performed the training. EHRS shall maintain all training records.

Calibration and/or certification of air monitoring instruments shall be conducted in accordance with the manufacturer's recommendations. EHRS shall conduct calibration, maintain records. and periodically inspect the calibration records to ensure completion.

The Confined Space Procedure will be reviewed annually or when Penn has reason to believe that measures taken may not protect employees or contractors that enter a space.

13. APPENDIX A – CONFINED SPACE ENTRY PROCEDURE

JOB PLANNING MEETING

1) Prior to entry into a confined space, personnel involved with the job will discuss the procedures that will be followed, so that the confined space work will be completed safely. The required equipment will be assembled; instructions will be conveyed to those involved in the entry; procedures will be discussed; and hazards, which may be encountered, will be explained. The attendant should ensure that any ignition source taken into the confined space is limited to ones required to perform the necessary work. Each location may have different hazards.

2) All necessary equipment to be used for entry will be assembled by the attendant, including communication devices
(radios, if required) to be used to quickly summon Rescue Personnel

ENTRY PROCEDURE

1) Follow Penn's Lockout/Tagout procedures to isolate any potential hazardous sources, which will adversely affect those working in confined space.

2) Open sufficient manhole covers, doors, vents, or other openings in the confined space.

3) Where necessary, use ventilators to change the air in the confined space.

4) A Qualified Employee will test the air for oxygen content, flammable and toxic gases (See Section 6.2). Initial air monitoring data will be recorded on the confined space permit. (See Attached Confined Space Permit)

a) Oxygen must be between 19.5% and 23.5%
b) Flammable/Explosive gases must be below 5% Lower Explosive Limit (LEL)
c) Toxic gases/vapors must be below OSHA's Permissible Exposure Limits

5) The Entry Supervisor will assign a trained Attendant to control entry into the confined space.

6) The Attendant will ensure that all Entrants are authorized; keep an accurate count of all who enter; continually communicate with those within the confined space; watch out for the well-being and safety of all entrants; and stay until relieved. Attendants will verify that all Entrants sign the Permit prior to entry.

7) If all is clear in step 6, the Entry Supervisor will authorize entry. Continuous forced ventilation should be used when required. Continuous air monitoring shall be conducted and recorded periodically on the back of the permit when required.

8) If work is stopped for any reason, the air tests shall be re-taken if deemed necessary by the Entry Supervisor, prior to re-entry.

9) When the job has been completed, the Attendant will account for all Entrants before they leave the job site.

10) The Entry Supervisor will check to ensure that all personnel are out, all equipment is clear, and when he is satisfied with the site conditions, he/she can close out the confined space entry permit, prior to allowing the Confined Space to be sealed.

14. APPENDIX B – ALTERNATIVE ENTRY PROCEDURES

This document lists the alternative entry procedures. It may be used as a checklist when permit space entry by the alternative procedures is allowed. The signature of the employer's representative verifies that the space is safe for entry. This certification shall be made before entry and shall be available to each employee entering the space.

Alternative entry procedures may be used in the following circumstances: The only hazard posed by the permit space is an actual or potential hazardous atmosphere; the employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain the permit space safe for entry; and the employer develops monitoring and inspection data that supports the demonstration that continuous forced air ventilation alone is sufficient to maintain the permit space safe for entry.

Permit Space Location/ID:_____Entry Date:_____

1. Eliminate any conditions making it unsafe to remove an entrance cover. List the hazards and precautions:

2. When the entrance covers are removed, promptly guard the entrance to prevent accidental falls through the opening and to protect the entrants from foreign objects. Describe the guards to be erected:

3. Before an employee enters the space, test the internal atmosphere for the following conditions, in the order given, and record below. List the acceptable range for the potential toxic air contaminants.

	Acceptable Range
Oxygen Content Background:_____ In Space:_____	**19.5% to 23.5%**
Flammable Gas and Vapors:_____	**0% to 10% LEL**

Carbon Monoxide: _____ **(0-25 ppm)** Hydrogen Sulfide:_____ **(0-10 ppm)***

*Short term exposure limit. May only work for 10-minutes at the maximum concentration shown.

Note: Allow at least 30 seconds for each reading with the extension tubing connected to the instrument.

4. Provide continuous forced air ventilation as follows:
   - An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere.
   - Forced ventilation is so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space.
   - The air supply for the forced air ventilation is from a clean source and does not increase the hazards in the space.

5. Continuous monitoring will be conducted. Employees must evacuate the space if the oxygen content drops below 19.5%, the flammable gas or vapor concentration is at or above 10% of the LEL, the toxic gases or vapor concentration exceeds 50% of the PEL.

6. azardous atmosphere is detected during entry, each employee shall leave the space immediately; the space shall be evaluated to determine how the hazardous atmosphere developed; and measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

Entry Roster: Include entrant name and time in and time out:

1_____ ____:____ ____:____ **2** _____ ____:____ ____:____

3_____ ____:____ ____:____ **4** _____ ____:____ ____:____

I, _____, certify that these procedures have been followed and that the confined space is safe for entry.

Entry Supervisor Signature:_____Date:_____

15. APPENDIX C – CONFINED SPACE INVENTORY

Confined Space Location	Description	Hazards	Space Labeled	Safety Requirements / PPE
Steam Manholes	Pits containing steam line	Atmospheric High Pressure Steam Heat Stress	Caution Confined Space Permit Required	Follow Confined Space Entry Permit Procedure Lockout/Tagout
Electrical Manholes	Pits containing electrical lines	Atmospheric Electrical Heat Stress	Caution Confined Space Permit Required	Follow Confined Space Entry Permit Procedure Lockout/Tagout
Air Handling Units	Without Energy recovery units	Mechanical	No	Lockout/Tagout
Air Handling Units	With Energy Recovery Units (BRB2/3, Johnson, CRB, Stellar Chance, Rosenthal)	Chemical/ Radiological Mechanical	Danger Do Not Enter Follow Service Procedure	Follow specific unit's entry procedure
MOD 6	ICE TANK PIT	Asphyxiation	Danger Permit Required Confined Space Do not enter	Follow Confined Space Entry Permit Procedure Lockout/Tagout
Sump Pit		Atmospheric		Lockout Tagout Follow Confined Space Entry Permit Procedure

Manhole Number	Manhole Location	GPS Location Longitude	GPS Location Latitude	Manhole Depth
002	In driveway, south side of South Street, between Museum and Parking Garage	W75Deg 11' 25.05"	N39Deg 56' 56.98"	7'-6"
003	In brick sidewalk, south side of South Street, in front of Museum	W75Deg 11' 27.43"	N39Deg 56' 58.65"	7'-10"
004	In concrete sidewalk, south side of South Street, in front of Museum	W75Deg 11' 27.73"	N39Deg 56' 59.15"	9'-7"
006	In sidewalk, south side of Spruce Street, in front of Maloney Wing of Hospital	W75Deg 11' 42.42"	N39Deg 57' 03.02"	8'-2"
007	In concrete plaza of Parking Lot 6, NE corner of 33rd and South, west of Franklin Field	W75Deg 11' 28.62"	N39Deg 57' 01.18"	7'-10"
007A	In driveway, SW corner of Hutchinson Gym	W75Deg 11' 21.30"	N39Deg 57' 02.9"	11'-10"
008	In concrete plaza of Parking Lot 6, NE corner of 33rd and South	W75Deg 11' 29.25"	N39Deg 57' 01.33"	10'-10"
008A	In ivy planter, NW corner of 33rd and South Street, outside Cret Chemistry Wing	W75Deg 11' 29.98"	N39Deg 57' 01.87"	10'-5"
008B	In concrete sidewalk, NW corner of 33rd and South Street, outside Cret Wing	W75Deg 11' 30.28"	N39Deg 57' 01.64"	
009A	In concrete sidewalk, SW corner of 334th and Spruce, at White Wing of Hospital	W75Deg 11' 34.74"	N39Deg 57' 01.52"	12'-4"
010	In driveway pavers, behind Irvine Auditorium, west side of 34th Street	W75Deg 11' 33.31"	N39Deg 57' 04.19"	7'-7"

010A	In brick walkway, at bicycle rack, SW of Duhring Wing	W75Deg 11' 35.01"	N39Deg 57' 04.64"	7'-0"
011A	In walkway pavers, along north edge of Hamilton Walk, between Towne and Vagelos	W75Deg 11' 30.44"	N39Deg 57' 05.85"	9'-5'
011B	In walkway pavers, along north edge of Hamilton Walk, between Towne and Hayden	W75Deg 11' 27.89"	N39Deg 57' 05.47"	8'-0"
012	In concrete sidewalk, west side of 34th Street, near Meyerson Hall	W75Deg 11' 32.17"	N39Deg 57' 08.78"	7'-4"
013	In concrete sidewalk, west side of 34th Street, NE of Meyerson Hall	W75Deg 11' 32.16"	N39Deg 57' 08.88"	8'-5"?
014	In grass lawn area and conc sidewalk, west side of 34th Street, NE of Meyerson Hall	W75Deg 11' 32.29"	N39Deg 57' 09.37"	13'-3"
018	In concrete sidewalk, NW corner of 34th and Samson, closest to wall at Silverman	W75Deg 11' 31.35"	N39Deg 57' 13.24"	10'-1"
019	In brick walkway, north side of Logan Hall	W75Deg 11' 40.55"	N39Deg 57' 05.80"	6'-11"
020	In lawn area, south side of Locust Walk, across from 3537 Locust Walk	W75Deg 11' 41.03"	N39Deg 57' 06.86"	10'-11"
021	In mulch, south side of Locust Walk, along north side of 300 S 36th Building	W75Deg 11' 43.11"	N39Deg 57' 07.06"	5'-5"
022	In ivy and mulch, south side of Locust Walk, between 300 S 36th and Steinberg/Dietrich	W75Deg 11' 43.39"	N39Deg 57' 07.13"	10'-7'
023	In brickwalkway, south side of Locust walk, in front of Steinberg / Dietrich Hall	W75Deg 11' 46.52"	N39Deg 57' 07.50"	8'-5"
024	In brick patio of the Arch Building, north side of Locust Walk	W75Deg 11' 43.14"	N39Deg 57' 07.54"	10'-4"
025	In brick walkway at entrance to Graduate Student Center, north side of Locust Walk	W75Deg 11' 44.23"	N39Deg 57' 07.78"	8'-4"
029B	In mulch planting bed, east side of 33rd Street, at David Rittenhouse Laboratories	W75Deg 11' 24.08"	N39Deg 57' 07.16"	10'-0"
030	In sidewalk, south side of Walnut Street, at Moore Graduate Research Wing	W75Deg 11' 26.58"	N39Deg 57' 09.15"	14'-10"
031	In sidewalk, north side of Walnut Street, at Hill House	W75Deg 11' 26.37"	N39Deg 57' 09.83"	9'-1"
033	In concrete sidewalk, at driveway adjacent to GRW, south side of Walnut Street	W75Deg 11' 27.89"	N39Deg 57' 09.23"	9'-4"
034	In concrete sidewalk, SW corner of 34th and Walnut Streets	W75Deg 11' 31.92"	N39Deg 57' 09.64"	9-5'/12'-5"
034A	In brick sidewalk, south side of Walnut Street, just east of Jaffe Building	W75Deg 11' 33.53"	N39Deg 57' 10.00"	16'-4"
035	In concrete sidewalk, south side of Walnut Street, at driveway to Van Pelt Library	W75Deg 11' 35.86"	N39Deg 57' 10.37"	9'-5"
036	In macadam driveway to Van Pelt Library, south side of Walnut Street	W75Deg 11' 38.05"	N39Deg 57' 10.58"	10'-6"
036A	In concrete sidewalk, north side of Walnut Street, at Franklin Building	W75Deg 11' 38.08"	N39Deg 57' 11.18"	13'-3'
037	In concrete sidewalk, at edge of Dietrich Library, south side of Walnut Street			8'-6"
037A	In conc sidewalk, under trash can, NW corner of Dietrich Library, south side of Walnut	W75Deg 11' 41.00"	N39Deg 57' 11.05"	9'-5"

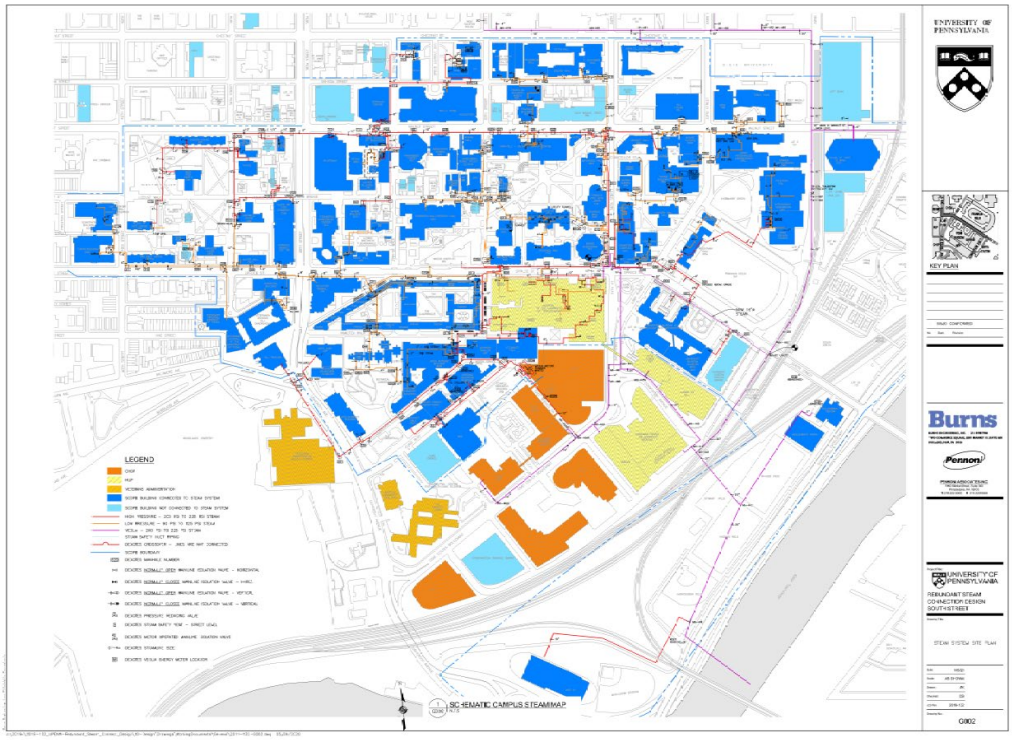
038	In concrete sidewalk, south side of Walnut Street, at Annenberg School	W75Deg 11' 44.34"	N39Deg 57' 11.45"	9'-7"
041	In future 37th Street Walkway (constr site), NE corner of Stiteler Hall	W75Deg 11' 48.98"	N39Deg 57' 11.00"	10'-4"
042	In ground cover and mulch, SW corner of 37th and Locust walk, near Phi Delta Theta	W75Deg 11' 49.57"	N39Deg 57' 07.85"	10'-0"
043	In ground cover and mulch, south side of Locust walk, near McNeil Building	W75Deg 11' 51.75"	N39Deg 57' 08.24"	11'-1"
044	In mud and grass, south side of Hamilton Walk, at Goddard Labs	W75Deg 11' 52.60"	N39Deg 56' 59.21"	11'-5"
044A	In grass, north side of Hamilton Walk, south of Quadrangle, near Richards Labs	W75Deg 11' 52.06"	N39Deg 57' 00.18"	8'-3"
045	In dirt area in Garden, north side of walkway, south of Goddard Labs	W75Deg 11' 52.77"	N39Deg 56' 58.16"	18'-10"
045A	In parking lot, west of John Morgan and behind Richards Labs	W75Deg 11' 50.88"	N39Deg 56' 58.06"	9'-9"
045B	In ground cover on steep bank, west of Anatomy Chemistry	W75Deg 11' 51.02"	N39Deg 56' 57.07"	9'-9"
046	Along bituminous walkway in Garden, east of Kaplan Hall	W75Deg 11' 55.19"	N39Deg 56' 58.42"	12'-1"
046A	In gravel walkwayof garden, south of Goddard Labs	W75Deg 11' 53.66"	N39Deg 56' 58.25"	14'-4"
181	In concrete sidewalk, north side of Samson Street, SW corner of Silverman Hall	W75Deg 11' 32.93"	N39Deg 57' 13.31"	6'-11"
182	In concrete sidewalk, north side of Samson Street, near Tanenbaum Hall	W75Deg 11' 35.85"	N39Deg 57' 13.63"	7'-2"
183	In concrete sidewalk, north side of Samson Street, near English House	W75Deg 11' 38.29"	N39Deg 57' 13.96"	7'-5"
201	In gravel section of patio at 300 S 36th Street, SW corner of 36th and Locust Walks	W75Deg 11' 42.54"	N39Deg 57' 07.02"	9'-9"
201A	In walkway pavers, SE corner of 37th and Locust Walks	W75Deg 11' 42.10"	N39Deg 57' 06.95"	14'-1"
229	In sidewalk, north side of Spruce Street, in front of Houston hall	W75Deg 11' 38.09"	N39Deg 57' 02.61"	10'-9 1/2"
230	In concrete sidewalk, north side of Spruce Street, at Williams Hall	W75Deg 11' 42.12"	N39Deg 57' 02.98"	14'-5'
230A	In walkway pavers, 36th Street Walk, at entrance to Williams Hall	W75Deg 11' 42.88"	N39Deg 57' 03.73"	8'-0"
241	In ivy and mulch, NW corner of 36th and Locust Walks, at Arch Building	W75Deg 11' 42.29"	N39Deg 57' 07.57"	9'-2"
242	In future 36th Street Walkway (constr site), SE of Addams Hall	W75Deg 11' 41.68"	N39Deg 57' 09.91"	8'-0"
254	In brick sidewalk at entrance to 3537 Locust Walk, north side of Locust Walk	W75Deg 11' 41.11"	N39Deg 57' 07.24"	5'-10"
254A	In brick sidewalk at entrance to Sweeten Alumni Center, north side of Locust Walk	W75Deg 11' 40.48"	N39Deg 57' 07.25"	5'-10"
301	In brick walkway, north side of Quadrangle, east of Stouffer Triangle	W75Deg 11' 51.78"	N39Deg 57' 03.05"	11'-5"
302	In concrete sidewalk, south side of Spruce Street, at Stouffer Triangle	W75Deg 11' 54.60"	N39Deg 57' 04.02"	11'-7"

303	In concrete sidewalk, SE corner of 38th and Spruce Streets	W75Deg 11' 56.41"	N39Deg 57' 04.25"	7'-11'
304	In concrete sidewalk, south side of Spruce Street, at Rosenthal Vet Building	W75Deg 11' 59.37"	N39Deg 57' 03.33"	16'-9"
304A	Pill Box Mechanical Room, adjacent to / behind Rosenthal Vet Building	W75Deg 11' 59.35"	N39Deg 57' 03.21"	10'-0"
305	In concrete sidewalk, north side of Spruce Street, west of 38th, at Parking Garage	W75Deg 11' 58.51"	N39Deg 57' 05.09"	10'-6"
306	In concrete sidewalk, north side of Spruce Street, at Mayer Hall	W75Deg 12' 00.64"	N39Deg 57' 05.35"	9'-6"
307	In concrete sidewalk, north side of Spruce, east of 39th Street Walkway	W75Deg 12' 02.32"	N39Deg 57' 05.51"	14'-9"
308	In concrete sidewalk, north side of Spruce, west of 39th Street Walkway	W75Deg 12' 03.05"	N39Deg 57' 05.67"	8'-5"
309	In concrete sidewalk, north side of Spruce, near Harrison House and 3905 Spruce	W75Deg 12' 05.38"	N39Deg 57' 05.95"	6'-10"
309A	In bituminous walkway, east of 3905 Spruce Street	W75Deg 12' 05.22"	N39Deg 57' 06.94"	5'-0"
310	In concrete sidewalk, north side of Spruce, at entrance to Van Pelt House	W75Deg 12' 08.52"	N39Deg 57' 06.33"	10'-7"
311	In concrete sidewalk, NE corner of 40th and Spruce Street	W75Deg 12' 10.63"	N39Deg 57' 06.60"	9'-11"
312	In planter (brick cover) inside fence at Evans Dental, west side of 40th Street	W75Deg 12' 11.39"	N39Deg 57' 07.52"	14'-8"
315	In concrete sidewalk, south side of Spruce Street, west of 36th Street Walk	W75Deg 11' 43.37"	N39Deg 57' 02.60"	13'-7"
315A	In concrete sidewalk, south side of Spruce Street, outside Quadrangle Dorms	W75Deg 11' 46.85"	N39Deg 57' 02.98"	14'-7"
316	in grass, west side of 36th Street Walk, SE of Quadrangle Dorms	W75Deg 11' 44.06"	N39Deg 56' 59.39"	11'-9"
317	In grass, north side of Hamilton walk, across from Johnson Pavilion entrance	W75Deg 11' 45.95"	N39Deg 56' 59.40"	6'-10"
318	In street at Guardian and North Service Drives, north of Nursing Building	W75Deg 11' 46.19"	N39Deg 56' 57.54"	10'-6"
319	In street of Guardian Drive, NW of Nursing Building	W75Deg 11' 47.34"	N39Deg 56' 56.93"	9'-2"
320	In mulch and vine planter, between Nursing and Cyclotron Buildings	W75Deg 11' 46.78"	N39Deg 56' 55.63"	12'-0"
321	In concrete sidewalk, north side of Currie Blvd, at Cyclotron Building	W75Deg 11' 46.88"	N39Deg 56' 55.35"	6'-8 1/2'
322	In street of Currie Blvd, below bridge between Stellar Chance and BRB2	W75Deg 11' 48.39"	N39Deg 56' 55.83"	12'-5"
323	In street of Currie Blvd, near intersection south of Nursing Education	W75Deg 11' 45.67"	N39Deg 56' 55.83"	8'-0"
324	In street at intersections of North and East Service Drives, south of Stemmler Hall	W75Deg 11' 42.61"	N39Deg 56' 57.18"	9'-3"
325	In street of North Service Drive, south of Stemmler Hall	W75Deg 11' 43.51"	N39Deg 56' 57.52"	9'-6"
325A	In street of East Service Drive, in underpass between CHOP and Wood Center	W75Deg 11' 39.8"	N39Deg 56' 54.28"	6'-9'

325M	In concrete sidewalk, west side of East Service Drive, behind Clinical Research Bldg	W75Deg 11' 41.58"	N39Deg 56' 56.53"	11'-6"
326	In street of Guardian Drive, behind John Morgan Building	W75Deg 11' 46.14"	N39Deg 56' 57.69"	10'-8"
327	In street of Guardian Drive, near John Morgan and Anatomy Chemistry Buildings	W75Deg 11' 47.81"	N39Deg 56' 56.96"	10'-6"
328	In street of Guardian Drive, between Anatomy Chemistry and Stellar-Chance Labs	W75Deg 11' 49.72"	N39Deg 56' 55.98"	10'-2"
329	In street of Guardian Drive, SW of Anatomy Chemistry Building	W75Deg 11' 51.87"	N39Deg 56' 55.03"	13'-4'
330	In street of Guardian Drive, near loading dock of Lynch Biology	W75Deg 11' 54.67"	N39Deg 56' 53.93"	12'-8"
331	In grass island between sidewalk and street, west side of Univ Ave, east of VA Hosp	W75Deg 11' 56.33"	N39Deg 56' 53.29"	12'-3"
332	In sidewalk on traffic island at intersection of 38th Street, Univ and Baltimore Avenues			11'-11"
401	In concrete sidewalk near curb, south side of Walnut Street, near Annenberg Center	W75Deg 11' 46.89"	N39Deg 57' 11.72"	12'-2"
402	In concrete sidewalk, SW corner of 37th and Walnut Streets	W75Deg 11' 48.68"	N39Deg 57' 11.93"	14'-1"
402A	In future 37th Street Walkway (constr site) SE corner of Graduate School of Education	W75Deg 11' 49.03"	N39Deg 57' 11.19"	13'-6"
403	In concrete sidewalk, south side of Walnut Street, at Graduate School of Education	W75Deg 11' 49.53"	N39Deg 57' 12.02"	12'-1"
404	In concrete sidewalk, north side of Walnut Street, at Gimbel Gymnasium	W75Deg 11' 49.35"	N39Deg 57' 12.69"	15'-0"
501	In concrete sidewalk, west side of 34th Street, between Walnut and Moravian Streets	W75Deg 11' 31.56"	N39Deg 57' 11.40"	8'-1"
601	In concrete sidewalk, SE corner of 33rd and Walnut Streets	W75Deg 11' 23.75"	N39Deg 57' 08.81"	12'-3"
602	Enter from Basement Mech Room of DLR, cover on sidewalk of Walnut St	W75Deg 11' 22.00"	N39Deg 57' 08.63"	11'-0"
603	In ivy planter between LRSM and Edison Building, north side of Walnut Street	W75Deg 11' 21.83"	N39Deg 57' 09.67"	12'-10"
701	In grass lawn (behind trailer), west of 39th Street Walk and east of Harnwell House	W75Deg 12' 01.63"	N39Deg 57' 08.50"	13'-7"
702	On raised slate pedistal, SE corner of 39th and Locust Walks	W75Deg 12' 01.47"	N39Deg 57' 09.43"	7'-10"
703	On slope, under Locust Street Bridge, west side of 38th Street near Dining Commons	W75Deg 11' 56.71"	N39Deg 57' 08.86"	9'-10"
704	In macadam walkway, south side of Dubois House	W75Deg 12' 04.13"	N39Deg 57' 12.98"	12'-3"
705	In macadam driveway, west of High Rise North	W75Deg 12' 06.73"	N39Deg 57' 11.72"	11'-4"
706	In mud and grass, east of 39th Street Walk, west of Fels Center	W75Deg 12' 00.95"	N39Deg 57' 12.47"	15'-6"
707	In sidewalk, SE corner of 39th and Walnut Streets	W75Deg 12' 00.74"	N39Deg 57' 13.43"	8'-7"
708	In concrete sidewalk, south side of Walnut Street, in front of President's House	W75Deg 11' 58.32"	N39Deg 57' 13.10"	9'-1"

709	In concrete sidewalk, SW corner of 38th and Walnut Streets	W75Deg 11' 56.16"	N39Deg 57' 12.86"	13'-8"
710	In concrete sidewalk, south side of Walnut Street, at Huntsman hall	W75Deg 11' 53.90"	N39Deg 57' 12.51"	9'-1"
711	In concrete driveway to underground garage, south side of Walnut, near Psych Labs	W75Deg 11' 51.72"	N39Deg 57' 12.17"	12'-4"
712	In concrete sidewalk, SW corner of 37th and Sansom Streets	W75Deg 11' 48.07"	N39Deg 57' 14.86"	13'-10"
713	In grass and dirt, west side of Sansom Place West, close to building	W75Deg 11' 45.96"	N39Deg 57' 16.15"	12'-2"
714	In street of Sansom Street, south of Sansom Place East, west of 36th Street	W75Deg 11' 42.53"	N39Deg 57' 14.21"	11'-7"
714A	In street of Sansom Street, south of Sansom Place East, near Inn at Penn	W75Deg 11' 43.02"	N39Deg 57' 14.29"	11'-10"
715	In macadam walkway, west of St Mary's Church, south of Locust Walk	W75Deg 12' 07.46"	N39Deg 57' 10.16"	8'-0"
CR1	In concrete sidewalk, west side of 34th Street, east of Irvine Auditorium	W75Deg 11' 33.20"	N39Deg 57' 03.75"	9'-2'
CR2	In concrete sidewalk, NE corner of 34th and Spruce Street	W75Deg 11' 33.00"	N39Deg 57' 02.34"	15'-0"
CR3	In concretesidewalk, east side of 34th Street, near Vagelos Labs	W75Deg 11' 32.50"	N39Deg 57' 04.11"	13'-8"
CR4	In mulch planter, north side of Spruce Street, at Cret Chemistry Wing	W75Deg 11' 30.99"	N39Deg 57' 01.75"	15'-9"
GATES	Enter from Basement Mech Room of Gates Pavilion, cover on sidewalk of Spruce St			15'-9"
ICR	Under Irvine Auditorium's front patio, NW corner of 34th and Spruce Streets			16'-6"

***The Steam Manhole map pictured below can be found on the EHRS T:drive and a large scale hard copy print out is located in the Steam Shop Office.**



16. APPENDIX D – CONFINED SPACE ENTRY PERMIT

PennEHRS
Environmental Health & Radiation Safety

FRES – CONFINED SPACE ENTRY PERMIT

Completion of this Entry Permit is required before the entry into any Permit Required Confined Space occurs.

ENTRY DESCRIPTION

Confined Space Location/Number: _____

Purpose of Entry: _____

Date Permit Issued: _____ Time of 1st Entry: _____ AM / PM Time Out: _____ AM / PM

PERMIT VALID FOR ASSIGNED TASK ONLY – NOT TO EXCEED ONE WORK SHIFT

SAFETY CHECKLIST

	Initials	N/A
Establish communication from worksite with PENNCOMM using # 511 from phone (direct line 215-573-3333)		
Types of Hazards:		
❑Oxygen-Deficient Atmosphere ❑Oxygen-Enriched Atmosphere ❑Engulfment ❑Toxic Atmosphere ❑Flammable Atmosphere ❑Entrapment ❑Hazardous Chemicals ❑Energized Electrical Equipment ❑Welding/Cutting ❑Heat		
Energy Sources Locked Out or Controlled:		
❑Electrical ❑Steam ❑Hydraulic ❑Pneumatic ❑Chemical ❑Thermal ❑Mechanical ❑Gravitational		
Barricades in position		
Established continuous ventilation/monitoring if required		
Communication Method(s) Used: ❑Verbal ❑Visual ❑Radio		
Personal Protective Equipment:		
❑Safety Shoes ❑Eye Protection (safety glasses) ❑Gloves ❑Head Protection ❑Hearing Protection ❑Full Body Harness ❑Respiratory Protection ❑Other: _____		
Rescue Equipment:		
❑Full Body Harness ❑Tripod & Winch		
Lighting Requirements		
Hot Work Permit Required? If welding/cutting operations are to be performed, attach hot work permit to entry form.		
Heat Stress:		
Pit Temp: _____ Ambient Temp: _____ Ventilation Installed? ❑Yes ❑No Employees trained on recognizing symptoms of heat stress? ❑Yes ❑No Cold Gatorade and/or Cold Water available? ❑Yes ❑No Time limitations in Confined Space? ❑Yes ❑No If Yes, indicate: _____		
Additional Information / Comments:		

PennEHRS
Environmental Health & Radiation Safety

ENTRY TEAM MEMBERS

NAME: (List First & Last Name Below)	TRADE
Attendant:	
Attendant:	
Entrant:	
Entrant:	
Entrant:	
Entrant:	

ATMOSPHERIC TESTING

Has the Air Monitoring Device been Bump Tested? ❑Yes ❑No

Is the Air Monitoring Device Calibration up to date? ❑Yes ❑No Calibration Date: _____

Any Equipment in need of repairs must be reported to the Supervisor who will take proper steps to have repairs made immediately.

Location in the Space	% O_2	% LEL	CO ppm	H_2S	Initials of Tester
Prior to Entry (At opening)					
Middle					
Bottom					
Acceptable Limits*	**19.5 –23.5%**	**Below 5%**	**Below 25 ppm**	**Below 5 ppm**	

* Continuous monitoring may be required. Site-specific conditions may require entrant to wear a monitor.
** Contact EHRS (215-898-4453) if any reading exceeds the acceptable limit.

AUTHORIZATION FOR ENTRY (All actions and/or conditions for safe entry have been performed)

Entry Supervisor (Print Name): _____ Signature: _____ Date: _____

RECORD OF ENTRY

Entrant's Name	Time In	Time Out	Time In	Time Out	Time In	Time Out	Time In	Time Out	Time In	Time Out

PERMIT CLEARANCE / CANCELATION (Entry has been completed and all entrants have exited the Permit Required Confined Space)

Entry Supervisor (Print Name): _____ Signature: _____ Date: _____

THIS FORM SHALL BE RETAINED BY THE SUPERVISOR FOR ONE (1) YEAR FROM DATE OF ISSUE