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# Confined Space Program

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### Resources

[OSHA – Standards and Enforcement](#)

[OSHA – Confined Spaces Overview](#)

[NIOSH – Confined Spaces](#)

## Purpose Statement

The purpose of the UNC Pembroke Confined Space Program is to define procedures that ensure workers safe entry into confined spaces to perform routine tasks associated with their employment. This procedure is designed to provide the minimum safety requirements in accordance with the Occupational Safety and Health Administration's (OSHA) Confined Space Standard, [1910.146](#).

## Scope

This standard applies to any operation that requires employees, inspectors, or contractors to enter and/or work inside any permit-required confined space. Examples include manholes, sewers, sumps, vaults, vats, pits, tunnels, tanks, or similar confined spaces.

The OSHA Confined Space definition:

1. A space that is large enough and so configured that an employee can enter bodily and perform assigned work;
2. A space that has limited means for entry or exit; and
3. A space that is not designed for continuous employee occupancy.

No confined space shall be entered until adequate precautions have been taken to ensure the safety of the entrant/s and their work environment.

The OSHA Permit Required Confined Space (entry by permit only) means a confined space that has one or more of the following characteristics:

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

## Definitions

1. Acceptable entry conditions - means the conditions that must exist in a permit space to allow employees to enter and work within the space.

2. Attendant - means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties.
3. Authorized entrant - means an employee who is authorized by the employer to enter a permit space.
4. Blanking or blinding - means the absolute closure of a pipe, line or duct by the fastening of a solid plate that completely covers the bore and is capable of withstanding the maximum pressure with no leakage.
5. Bump Testing - functional (bump) testing, a means of verifying by using a known concentration of test gas to ensure acceptable performance of sensors and monitor before use.
6. Confined space - means a space that:
  - a. is large enough that an employee can bodily enter and perform assigned work; and
  - b. Has limited means for entry or exit; and
  - c. Is not designed for continuous employee occupancy.
7. Double block and bleed - means 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.
8. Emergency - means any occurrence (including any failure of hazard control or monitoring equipment) or events internal or external to the permit space which could endanger entrants.
9. Engulfment - means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance.
10. Entry - means 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.

11. Entry permit - (permit) means the written or printed document that is provided by the employer to allow and control entry into a permit space.
12. Entry supervisor - means the person responsible (such as the employer, foreman, or crew chief) for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this standard.
13. Hazardous atmosphere - means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (unaided escape from a permit space), injury, or acute illness from one or more of the following causes:
  - a. A flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
  - b. An airborne combustible dust at a concentration that meets or exceeds its LFL; (This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet or less).
  - c. An atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
  - d. Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart Z, which could result in employee exposure in excess of its dose or permissible exposure limit.
  - e. Any other atmospheric condition that is immediately dangerous to life or health.
14. Hot work permit - means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.
15. Immediately dangerous to life or health (IDLH) - means any condition which 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.
16. Inerting - means the displacement of the atmosphere in a permit space by a

noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible. (Note: This procedure produces an IDLH oxygen-deficient atmosphere).

17. Isolation - means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.
18. Line breaking - means the intentional opening of a pipe, line or duct that is or has been carrying flammable, corrosive or toxic materials, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.
19. Non-permit confined space - means a space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.
20. Oxygen deficient atmosphere - means an atmosphere containing less than 19.5 percent oxygen by volume.
21. Oxygen enriched atmosphere - means an atmosphere containing more than 23.5 percent oxygen by volume.
22. Permit-required confined space - (permit space), means a confined space that has one or more of the following characteristics:
  - a. Contains or has the potential to contain a hazardous atmosphere;
  - b. Contains a material that has the potential for engulfing an entrant;
  - c. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
  - d. Contains any other recognized serious safety or health hazard.
23. Permit-required confined space program - (permit space program) means the employer's overall program for controlling, and, where appropriate, for protecting

employees from, permit space hazards and for regulating employee entry into permit spaces.

24. Permit system - means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.
25. Prohibited condition - means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.
26. Rescue service - means the personnel designated to rescue employees from permit spaces.
27. Retrieval system - means the equipment (including a retrieval line, chest or full body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.
28. Testing - means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

## **Program Responsibilities**

Environmental Health and Safety Office (EHS):

- Serves as primary resource and point-of-contact on confined space issues;
- Maintains, revises, and distributes this program to appropriate campus departments;
- Assists in the evaluation and identification of confined spaces;
- Oversees field calibration of atmospheric monitoring equipment used for confined space entry work;
- Performs any additional specialty air monitoring or testing; and
- Develops and assists with conducting confined space training.

Entry Supervisors:

- Determines if acceptable entry conditions are present at a permit space where entry is planned;
- Verifies the Permit information to ensure all tests and requirements are in place.
- Signs Permit and allows entry into space;
- Terminates the entry and cancels Permit when appropriate;
- Verifies rescue services are available and communication system is functioning;

- Removes unauthorized entrants.

#### Entry Attendants:

- Receive confined space training to safely observe and support entrants from outside of confined spaces;
- Prevent entry by unauthorized personnel;
- Understand the hazards or potential hazards of confined spaces; and
- Inform authorized entrant to evacuate, when conditions become unacceptable.

#### Authorized Entrants:

Make actual entries into confined space, and have been trained and authorized to:

- Understand confined space hazards;
- Use personal protective equipment and entry tools and supplies;
- Follow proper entry procedures and perform assigned job tasks;
- Communicate with attendant; and
- Evacuate space immediately, if necessary.

Exit the permitted space whenever:

- Ordered by Attendant or Entry Supervisor;
- Entrant recognizes warning signs or symptoms of danger;
- Entrant detects prohibited condition;
- Evacuation alarms are activated; and
- Attendant has to leave his/her monitoring location for any reason.

## Potential Hazards

1. Oxygen Deficiency - Atmospheres containing less than 19.5% oxygen are considered to be oxygen deficient. Normal breathing air contains 20.9% oxygen. Atmospheres with more than 23.5% oxygen are oxygen enriched and are immediately dangerous to life and health (IDLH).

Some of the more common causes of oxygen deficiency are:

- Oxidation of metals (rusting);
  - Bacterial action in sewers, which consumes oxygen and produces carbon dioxide and hydrogen sulfide;
  - Fuel combustion – which uses oxygen and produces carbon monoxide; and
  - Displacement by other heavier gases, such as Argon.
2. Combustible Gases and Vapors - These hazards are naturally occurring gases (natural gas) and the vapors of a large group of liquids which are used as fuels and solvents. Some of these liquids vaporize easily when placed in open air. Both gases



and vapors may burn or explode when mixed with the required amount of air and an ignition source.

- a) Many combustible & flammable gases/vapors are heavier than air and will flow down to the lowest point of a pit, tank, or opening in a confined area while other gases may be lighter than air and collect at the top of the space.
  - b) Many of these combustible gases/vapors are also toxic such as, petroleum solvents (paint thinner, gasoline, lacquer thinner) vapors when they are concentrated in a confined space without adequate ventilation.
3. Toxic Atmospheres - Gases and vapors which are known to produce disease, acute discomfort, bodily injury or death are atmospheric toxins. The two main classifications of gases found in these atmospheres are irritants and asphyxiants.
- a) Irritants - Gases which are irritating to the respiratory and nervous system at low levels and may cause death at higher levels. An example is hydrogen sulfide which can occur naturally or as a by-product of natural decomposition of organic material.
  - b) Asphyxiants - These are gases which cause asphyxiation by displacing the oxygen in the atmosphere or by chemically interacting with respiratory mechanisms in the body. Three common examples are methane, hydrogen sulfide (sewer gas) and carbon monoxide. Methane and Hydrogen Sulfide is often encountered in sewers, storage bins, and tunnels. Carbon monoxide is the common toxic product of combustion.

#### 4. General Safety Hazards

- a) Mechanical and Electrical – De-energization of mechanical and electrical systems must be completed to eliminate these hazards before entry into a confined space by an entrant. Special precautions must be taken to ensure that static electricity or other ignition sources are disconnected and other mechanical hazards are protected.
- b) Communication Problems - When visual monitoring of the worker is not possible, two way radio is necessary to ensure communication between the entrant and the attendant.
- c) Entry and Exit - Entry and exit time is a major factor because of physical limitations. These spaces can force employees to work in positions that are

hard on the body.

d) Physical - Physical hazards include thermal effects, noise, vibration, slick/wet surfaces, rotation, fatigue, engulfment, and falling objects.

1. Thermal factors are air temperature, radiant heat exchange, and air movement. If the space is hot with a large amount of residual heat, such as a boiler or steam manhole, it must be allowed to cool before any entry. Allow boilers at least 3 days to cool before attempting entry into the various compartments. Allow steam manholes enough time to cool and reach zero pressure on steam supply and condensate return lines before entry. Monitor entrants for signs of heat stress when entry is made into hot environments. To protect workers from heat stress/stroke, institute work-rest procedures to 15 minutes of work in a hot enclosed space.
2. Operations that generate vibrations also produce noise which may further interfere with communication and generate static electricity which could provide a source of ignition in atmospheres with flammable or combustible vapors.
3. Rotational Hazards, such as electric motor shafts, fan belts, fan blades and blower squirrel cages pose physical hazards to entrants that must be controlled by de-energization (LO/TO) before entry into a confined space.
4. Slick/wet Surfaces - Aside from slip and fall hazards, a wet surface will increase the likelihood for electric shock in areas where electrical circuits, equipment, and tools are used.
5. Fatigue - Work/rest cycles should be determined prior to entry based upon temperature, humidity level and space limitations and modified as required.
6. Engulfment hazards exist where a worker is surrounded by granular substances such as soil, gravel, or sand or potentially submerged in a liquid such as water or chemicals. Engulfment can cause physical harm by constriction, crushing, strangulation, or suffocation.
7. Electrical Hazards- Confined Spaces may also present electrical shock or electrocution hazards from potentially defective cables, the presence of water (flooded vault) in contact with electrical wiring, or by accidental physical contact with charged cables or wire leads. Employees are cautioned NOT TO ENTER THE SPACE if an electrical shock potential is

identified.

8. Lighting – being able to see is often an important part of getting the work done. However, overhead lighting is not typically installed in these spaces so it has to be planned for when entering these spaces. Also, not every light source is certified for a confined space environment. If entering a flammable atmosphere, any unapproved electrical lighting sources could have unprotected circuitry.
9. Lockout/Tagout – proper lockout/tagout and hazardous energy control procedures should be followed when workers are in confined spaces.

## General Requirements

1. Work areas will be evaluated to determine if they meet the definition of OSHA confined spaces. Additionally, confined spaces that meet the definition of permit-required confined spaces will be designated and specific entry permits drafted.
2. Permit-required confined spaces will be identified and employees informed of their existence, location, and danger by posting a "Danger – Permit Required Confined Space" sign.
3. A written Permit-Required Confined Space program will be used (See Appendix I, Permit Required Confined Space Program).
4. Entry permits will be issued for each entry into a permit required confined space.
5. When there are changes in the use, risk/hazard level or configuration of a non-permit or permit required confined space, it will be re-evaluated and reclassified as appropriate.
6. When outside contractors are involved in permit confined space entry:
  - a) The contractor will follow the confined space entry requirements as described in the University Contractor Safety Program. The contractor should be in close contact with their designated UNC-Pembroke Project Manager to ensure that they are in compliance with the Contractor Safety Program.
  - b) EH&S shall be notified prior to all Confined Space entries.

## Training

1. Training is provided to ensure understanding, knowledge, and skills are developed for assigned duties.
2. Training is provided:
  - a. Before initial assignment.
  - b. When there is a change in the confined space entry requirements.
  - c. When inappropriate deviations in program have been identified or employee knowledge levels indicate that additional training is warranted.
  - d. Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures or that there are inadequacies in the employee's knowledge or use of these procedures.
3. Employees must establish proficiency in duties as assigned.
4. Certification of training includes trainee names, date of-training and trainer's signature.

## Rescue and Emergency Services

1. Lumberton Rescue provides rescue and emergency services.
  - a. Lumberton Rescue must be informed of potential confined space hazards involved in rescue.
  - b. Access must be provided to all permit-required spaces for fire department /rescue team training purposes.
  - c. Rescue team must be trained and equipped for and proficient in performing the needed rescue services.
2. To facilitate non-entry vertical rescues, retrieval systems must be used for

authorized entrants, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.

- a. Each Entrant shall use a body harness with a retrieval line attached.
  - b. The other end of the retrieval line shall be attached to a mechanical device for any vertical permit-required space more than 5 feet deep.
  - c. Contact the Environmental Health and Safety Office for guidance in situations where the use of body harness, retrieval line and mechanical device could endanger the employee.
3. If exposure occurs to a substance for which a Safety Data Sheet (SDS) is required, the SDS must be provided to the medical facility.

# Appendices

## Appendix I

### Permit Required Confined Space Program

- A. Prevent unauthorized confined space entry. As outlined in each permit-required confined space permit, precautions such as cordoning/barricading the work area to prevent entry by students and other people must be employed to prevent unauthorized entry.
- B. Identify and evaluate hazards before entry. If an additional permit required confined space are identified, please contact the Environmental Health and Safety Office before entry.
- C. Safe permit entry operations include:
  - 1. Ensuring all attendants, entrants and entry supervisors have received the appropriate level of training to perform their duties.
  - 2. Obtaining a permit for the type of permit required confined space.
  - 3. Ensuring all mandatory equipment has been inspected, is in good working order, and is listed on the permit. This includes personal protective equipment (PPE).
  - 4. Ensuring the work area is properly barricaded to prevent unauthorized entry.
  - 5. The attendant, entry supervisor and/or entrant should complete the entry permit. Special precautions should be administered before opening a confined space, especially manhole covers. This includes, but is not limited to, eliminating any hazards and guarding the opening (standard guardrail, temporary cover, etc.). The entry supervisor should review all information and certify accuracy by signing the entry permit and posting at the job site.
  - 6. The attendant, entrant and entry supervisor should pay particular attention to atmospheric testing (Multi-gas meter), purging, inserting, flushing, lock out tag out and/or ventilating the permit space as necessary to control the hazards. Please note: Continuous, forced air ventilation shall be used, as follows:
    - a. If a hazardous atmosphere is detected by the 4 gas meter. An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere.
    - b. The air ventilation shall be 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.
    - c. The air supply for the forced air ventilation shall be from a clean source

and may not increase the hazards in the space.

7. Once all precautionary measures have been taken and conditions are acceptable for entry, the authorized entrant may enter the confined space.
  - a. The permit must be canceled after work has been completed and cannot be in force for more than 24 hours. The entry supervisor, attendant or authorized entrant may cancel the permit by indicating the expiration date/time on the permit. A copy of the canceled permit must be forwarded to the Environmental Health and Safety Office.

D. The following equipment may be mandatory depending on the specific confined space to be entered:

1. Air testing and monitoring equipment.
2. Ventilating equipment.
3. Communications equipment.
4. Personal protective equipment where engineering and work practice controls are insufficient.
5. Adequate lighting equipment.
6. Barriers and shields.
7. Equipment for safe ingress and egress.
8. Rescue and emergency service equipment.
9. Body Harness.

E. Equipment Maintenance and Calibration

Each Department is responsible for maintaining Confined Space equipment and for ensuring that the equipment is properly operating prior to each use.

Multi-gas meters, for atmospheric testing, must be "bump tested" (if required) before each use and calibrated per the manufacturer's instruction. Bump Testing: functional (bump) testing, a means of verifying by using a known concentration of test gas to ensure acceptable performance of sensors and monitor before use.



- F. Evaluation of permit space conditions
  - 1. Pre-entry testing for acceptable entry conditions is required before entry and periodic testing for the duration of the operation.
  - 2. Where it is not feasible to isolate the space (as in sewers) continuous monitoring is required.
  - 3. Tests for atmospheric hazards require testing in this order (1) oxygen, (2) combustible gases and vapors, and (3) toxic gases and vapors.
- G. One Attendant is required to be outside the permit space for the duration of entry operations. Please contact the Environmental Health and Safety Office if multiple spaces and/or entrants need to be monitored by one attendant.
- H. Duties are established and training provided for all participants.
- I. Rescue and emergency services are provided by Lumberton Rescue only. The Attendant will be in radio contact with Campus Police who will summon Lumberton Rescue.
- J. Entry operations follow the coordinated entry provisions when contractors or other employers are involved.
- K. A Permit-Required Confined Space Program review is conducted:
  - 1. At least annually; and
  - 2. Whenever there is reason to believe deficiencies may exist.
- L. A mandatory Entry Permit System is used for all permit-required confined space entries.
  - 1. An Entry Permit must be completed prior to entry authorization and be signed by the identified Entry Supervisor.
  - 2. The Permit must be available at all times to authorized Entrants at or near the point of entry.
  - 3. The permit may not exceed the time required to complete the assigned task. **Permits are valid for a maximum 24-hour period.**
  - 4. The Entry Supervisor will terminate entry and cancel the Permit when:
    - a. Entry operations have been completed or

- b. A condition not allowed by the Permit arises.
5. Canceled Permits must be retained for at least 1 year by the issuing Department to facilitate program review. A copy of the cancelled permits is to be forwarded to the Environmental Health and Safety Office.

## Atmospheric Testing Procedures

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

- (1) **Evaluation testing.** The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space.
- (2) **Verification testing.** The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. Results of testing (i.e., actual concentration, etc.) should be recorded on the permit.
- (3) **Duration of testing.** Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.
- (4) **Testing stratified atmospheres.** When monitoring for entries involving entering into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side.
- (5) **Order of testing.** A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.



University of North Carolina at Pembroke
CONFINED SPACES ENTRY PERMIT

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IDENTIFICATION
Name of confined space:
Location:
Space description:
Contents:
Interior dimensions:
Access type: Access size:
[ ] Permit Required (complete Entry Permit below) [ ] Non-Permit Required

POTENTIAL HAZARDS (Check all that apply)
Hazardous atmosphere: Minimum work room: Hazardous residue:
Engulfment Sloped walls Poor lighting:
Entrapment No fixed ladder Poor footing:
Hazardous energies Fall hazard: Hot surfaces:
Other (specify):

REQUIRED PRECAUTIONS
Atmos. testing (circle): periodically / continuously Ventilation (circle): if indicated by monitoring /
Surveillance (circle): visual / verbal / radio prior / continuously
/other
Safety harness/ lifeline: yes / no Safety hoist (circle): yes / no
Lockout/tagout: Barricade opening: yes / no
Respirator (specify): Other PPE
(specify):
Other (specify):

ENTRY PERMIT
Scope of work authorized:
Hot work authorized? [ ] NO [ ] YES Scope:
Entry authorized by: Date:
Authorized Entrants and Attendant (may alternate [ ] YES or [ ] NO)
1. 2. 3.
4. 5. 6.
Reviewed/Cancelled by

