

CONFINED SPACES

INTRODUCTION

Working in confined spaces presents unique hazards because environmental conditions can change rapidly and it may be difficult to quickly exit the space. Some of the most common problems associated with confined spaces include hazardous atmospheres (e.g. reduced oxygen, flammable, toxic), slippery surfaces, electric shock, poor illumination, and flooding. This chapter describes the procedures to be used for entry into these spaces. If an oxygen deficiency hazard (ODH) exists as identified by Fermilab Environment, Safety and Health Manual (FESHM) Chapter 5064 and is within a confined space, the confined space entry team is also expected to follow any training and monitoring requirements found within FESHM Chapter 5064.

APPLICABLE STANDARDS OR REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) for Chemical Substances and Physical Agents, and Biological Exposure Indices

Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations 1910.146 – Permit-required confined spaces

OSHA 29 CFR 1910 Subpart Z – Toxic and Hazardous Substances – Permissible Exposure Limits (PEL)

DEFINITIONS

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

Authorized Attendant - A trained employee, subcontractor, or scientific user who is stationed and remains outside of the confined space for the purpose of monitoring the

entrants and who performs all attendant's duties. An attendant shall be stationed outside any confined space requiring a permit for each job assignment.

Authorized Entrant - A trained employee, subcontractor, or scientific user who will enter a confined space.

Confined Space - A space that:

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

“Restricted entry or exit,” means physical impediment of the body, e.g., use of the hand or a contortion of the body to enter into, or exit from, the space. Underground beamline enclosures are not usually considered confined spaces. Enclosures that can be accessed by a ladder with no other access/egress points are considered confined spaces. The Landlord ES&H Department shall evaluate large-scale excavations on a case-by-case basis.

Confined Space Entry Permit - The written or printed document established by Fermilab, the contents of which are based on the hazard identification and evaluation for that confined space and is the instrument by which Fermilab authorizes its authorized entrants to enter confined spaces.

Confined Space Reclassification Form – A form that allows a division/section to reclassify a permit-required confined space as a non-permit confined space provided that certain conditions are met.

Construction Coordinator – A division/section designated individual specifically assigned to oversee the work of a fixed-price construction subcontract for conformance to the subcontract documents.

Emergency - Any occurrence or change of conditions (including any failure of hazard control or monitoring equipment) internal or external to the confined space that could endanger entrants.

Engulfment - The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can cause death.

Entry - The act by which a person passes through the opening into a confined space. The entrant is considered to have entered as soon as any part of the entrant's body breaks the plane of an opening into the space.

Entry Supervisor – A trained employee, subcontractor or scientific user responsible for determining if acceptable entry conditions are present where entry into a confined space is planned, for authorizing entry and overseeing entry operations, and for terminating entry.

Functional Landlord - Division/Section which routinely enters the confined space.

Hazardous Atmosphere - An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a confined space) injury, or acute illness from one or more of the following causes:

- (1) Flammable gas, vapor, or mist in excess of 10 percent of its lower explosive limit;
- (2) Airborne combustible dust at a concentration that meets or exceeds the lower explosive limit;
- (3) Atmospheric oxygen concentration below 19.5% or above 23.5%;
- (4) Atmospheric concentration of any substance which may exceed either the OSHA PEL or the ACGIH TLV for that substance;
- (5) Any other atmospheric condition that is immediately dangerous to life or health.

NOTE: For air contaminants for which ACGIH or OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

IDLH (Immediately Dangerous to Life or Health) - Any condition which poses an immediate or delayed threat to life or that would cause irreversible adverse effects or that would interfere with an individual's ability to escape unaided from the confined space.

Landlord – Division/Section responsible for the space.

LEL (Lower Explosive Limit) - The lowest concentration of gas or vapor (% by volume in air) that will burn or explode if an ignition source is present at ambient temperatures.

Non-Permit Confined Space - A confined 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.

CAUTION: Introducing a hazard (e.g., welding, painting, chemical use, etc.) into a non-permit confined space may cause the space to become a permit-required confined space.

Oxygen Deficient Atmosphere - An atmosphere containing less than 19.5% oxygen by volume.

Oxygen Enriched Atmosphere - An atmosphere containing more than 23.5% oxygen by volume.

PEL (Permissible Exposure Limit) - An exposure limit established by OSHA.

Permit-Required Confined Space:

If the confined space has one or more of the following characteristics, the entry will require a permit to be valid for the duration of the job as long as the conditions specified on the permit do not change:

1. Contains, or has a 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; or
4. Contains any other recognized serious safety or health hazard.

Service Coordinators - For the sake of this chapter, Service Coordinators are considered Task Managers.

Task Manager – A division/section designated individual specifically assigned to oversee and direct a work activity.

TLV (Threshold Limit Value) - An exposure limit that is published by ACGIH.

Toxicity - All of the adverse biological effects resulting from an exposure to a harmful substance.

Welding/Burning/Brazing Permit - An operation that requires a Welding/Burning/Brazing Permit per FESHM Chapter 2020.

RESPONSIBILITIES

Divisions/Sections

1. Implements this policy.
2. Develops confined space entry notification methods in coordination with other divisions and sections.
3. Documents Landlord ES&H Department's signature approval requirements in an internal written procedure that is communicated to all affected personnel.
4. Maintains an inventory of confined spaces for which they are Landlord. New confined spaces may be generated or existing confined spaces updated with the aid of the Confined Space Entry Form (End of Chapter). Landlords may obtain database information about the characteristics of the space from the Functional Landlord(s). The inventory is maintained on the ES&H Web-site. This database indicates which permit-required confined spaces might be reclassified.
5. Gives Fermilab specific training for Fermilab employees (including rented technicians), and scientific users who will work in confined spaces. All training records shall be entered into TRAIN.
6. Provides the confined space entry team, Task Managers, and Construction Coordinators with expertise regarding entry procedures and hazard control strategies for Fermilab or subcontractor employees. Direct communication with employees or subcontractors may be needed, depending on the scope of the project.
7. Label confined spaces for which they are Landlord per the general requirements of this Chapter.
8. Maintains monitoring equipment required by this chapter for use by Fermilab employees and scientific users and calibrates monitoring equipment immediately prior to use.

9. Reviews annually, or more frequently, their confined space permits, reclassification forms and program for effectiveness. The review shall include division/section projects, and division/section construction coordinator and task managed projects.

ES&H Section

1. Provides a uniform training program for the divisions/sections to use for work in confined spaces.
2. Provides expertise to divisions/sections on all aspects of confined space entry.
3. Provides a supply of signs to denote confined spaces, which reads "Confined Space"
4. Maintains lab-wide confined space database on the ES&H Web-site that contains an inventory of confined spaces.

Task Manager/Construction Coordinator

1. Informs subcontractors that the workplace contains confined spaces and that entry is allowed only through a confined space permit system meeting the requirements of OSHA's Permit-Required Confined Space standard, 1910.146. Additional requirements are located in this chapter.
2. Apprises subcontractors of the hazards associated with the confined space(s).
3. Apprises the subcontractor of any precautions or procedures that have been implemented for the protection of employees in or near the confined space where subcontractor personnel will be working.
4. Ensures that confined space activities are completed in accordance with the subcontractor's confined space entry program.
5. Coordinates entry operations with the subcontractor when both Fermilab and subcontractor personnel will be working in or near the confined space.
6. Notifies Fire Department, and Landlord and Functional Landlord as designated in the division/section implementation documents prior to entry. Information

shall include the location of the entry, the number of entrants and the nature of the work.

7. Debriefs the subcontractor at the conclusion of the entry operations regarding any hazards confronted or created in the confined space during entry operations.

Entry Supervisor

1. Knows the hazards that may be encountered during entry, including information on the mode, signs and/or symptoms, and consequences of the exposure and prepares written procedures as may be required for entry. These procedures should be revised whenever conditions change the hazards associated with the entry.
2. Verifies, by checking that the appropriate information has been entered onto the permit, that all tests specified on the permit have been conducted, and that all entry procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.
3. Notifies Fire Department, and Landlord and Functional Landlord as designated in the division/section implementation documents prior to entry. Information shall include the location of the entry, the number of entrants and the nature of the work.
4. Determines that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained, including whenever responsibility for a confined space entry operation is transferred to another organization.
5. The entry supervisor may also serve as the attendant or entrant, provided that they have received the necessary training and can adequately fulfill the duties and responsibilities of each position.
6. Verifies training of attendant and entrants.
7. Communicates entry procedures to attendants and entrants.
8. Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations.

9. Passes duties to another entry supervisor if the permit confined space entry continues over multiple shifts.
10. Terminates the entry and cancels the permit when the entry operations covered by the entry permit have been completed or when a condition that is not allowed under the entry permit arises in or near the permit space. In the event conditions arise which are not authorized on the permit, the entry supervisor shall notify the Landlord and Functional Landlord.

Authorized Attendant

1. Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms (including any possible behavioral effects), and consequences of the exposure.
2. Continuously maintains an accurate count of authorized entrants in the confined space.
3. Remains outside the confined space during entry operations until relieved by another attendant, or entry is terminated.
4. Maintains constant communication with authorized entrants (voice, radio, etc.) and makes contact with entrants as necessary to monitor their status.
5. Monitors activities inside and outside of the confined space to determine if it is safe for entrants to remain in the space. This includes air monitoring. Orders the authorized entrants to evacuate the permit space immediately under any of the following conditions:
 - a. If the attendant detects conditions that are not authorized by the permit.
 - b. If the attendant detects signs and/or symptoms of hazard exposure to the entrant.
 - c. If the attendant detects a situation outside the confined space that could endanger the entrants.
 - d. If the attendant cannot effectively and safely perform all duties required.

6. In the event of an emergency, notifies the Fermilab Fire Department immediately. If a phone is immediately available, calls the Emergency Operator at Ext. 3131 or 840-3131. Radio communications should be used where phones are not immediately available.
7. Takes the following actions when unauthorized persons approach or enter a confined space:
 - a. Warns the unauthorized persons that they must stay away from the confined space.
 - b. Advises the unauthorized persons that they must exit immediately if they have entered a confined space.
 - c. Informs entrants and entry supervisor if unauthorized persons have entered the confined space.
8. Performs non-entry retrievals if trained on equipment.
9. Performs no duties that might interfere with the attendant's primary responsibility of monitoring the entrants.

Authorized Entrant

1. Knows the hazards that may be encountered during entry, including information on the mode, signs and/or symptoms, and consequences of exposure.
2. Uses safety equipment properly. This may include air monitoring as a result of space configuration or work activity performed.
3. Communicates with attendant as necessary to enable the attendant to monitor entrant status and enable the attendant to evacuate the space as required.
4. Alerts attendant whenever:
 - a. The entrant recognizes any warning sign and/or symptom of exposure to a dangerous situation.
 - b. The entrant detects a prohibited condition.

5. Exits from the confined space as quickly as possible whenever:
 - a. An order to evacuate is given by the attendant or entry supervisor.
 - b. The entrant recognizes any warning sign and/or symptom of exposure to a dangerous situation.
 - c. The entrant detects a prohibited condition.
 - d. An evacuation alarm is activated.

NOTE: Any qualified individual may fill one or more of the above mentioned roles as long as that person is trained and equipped for each role (an attendant may **not** simultaneously serve as an entrant during an entry operation).

Fermilab Fire Department

1. Shall perform entry-required rescues from confined spaces.
2. Shall annually perform confined space rescue drills.
3. Each member of the Fermilab Fire Department shall be trained to perform the assigned rescue duties and shall be provided with, and be trained to use properly, the personal protective equipment and rescue equipment necessary for making rescues from permit spaces. In addition, each member of the Fermilab Fire Department shall be trained in basic first aid and in cardiopulmonary resuscitation (CPR). At least one member at the rescue scene must hold current certification in first aid and in CPR.

Subcontractors

1. If a subcontractor is required to enter a permit required confined space as part of their contract with Fermilab, the subcontractor shall provide the Fermilab Construction Coordinator/Task Manager with the following information to allow for adequate review prior to entry:
 - a. A written copy of their confined space entry program.

- b. Training records for potential entrants, attendants, and entry supervisors.
 - c. Evidence that all air monitoring equipment is properly calibrated within the calibration period specified by the subcontractor's program or manufacturer's instructions. This may be in the form of a calibration log, certification indicator on the instrument, or other means. (It is imperative that the equipment used by the subcontractor be capable of monitoring for the contaminants associated with the confined space to be entered.)
2. It will be the subcontractor's responsibility to provide all of their own personal protective equipment (PPE), such as lifelines, harnesses, respirators, tripods, ventilators, etc., as specified by the entry permit.
3. In addition to complying with the permit space requirements listed above, each subcontractor retained to perform permit space entry operations shall:
 - a. Obtain any available information regarding permit space hazards and entry operations from Fermilab.
 - b. Coordinate entry operations with Fermilab, when both Fermilab personnel and subcontractor personnel will be working in or near permit spaces.
 - c. Prior to entry, inform Fermilab Construction Coordinator/Task Manager of the specific permit space procedures the subcontractor will follow.
 - d. Inform the Fermilab Construction Coordinator/Task Manager prior to entering the space.
 - e. Inform Fermilab Construction Coordinator/Task Manager of any unanticipated hazards confronted during the confined space entry.
 - f. Provide the Fermilab Construction Coordinator/Task Manager with a copy of the subcontractor's confined space permit, reclassification form or written certification once the work has been completed.
4. Per OSHA 1910.146 (c) (5), if the subcontractor can demonstrate that continuous forced air ventilation alone is sufficient to maintain safe entry conditions, then the job specific confined space entry procedures can be modified by the Landlord ES&H Department.

GENERAL REQUIREMENTS

1. Each division/section shall evaluate their workplaces to determine if any spaces fit the definition of a confined space. The inventory of confined spaces shall be documented in the Confined Space Database on the ES&H Web-site.
2. The Landlord, in conjunction with the Functional Landlord(s), of the confined space shall conduct a hazard assessment of confined spaces to determine if they are permit-required confined spaces.
3. Permit-Required confined spaces that can be easily or inadvertently entered must be labeled with a sign outside the space that states, DANGER - CONFINED SPACE. Other confined spaces which require keys, tools, or special procedures to enter, do not have to have signs posted outside them, as long as equally effective arrangements are made to prohibit unauthorized entry (training, special procedures, etc.).
4. Each division/section shall evaluate their confined space entry program on an annual basis against the requirements defined in Fermilab's program.

PERMIT-REQUIRED CONFINED SPACE ENTRY PROCEDURES

Listed below are the requirements for permit-required confined space entry procedures when any Fermilab employee or scientific user (1) enters the space or (2) serves as entry supervisor.

1. Assign roles of entry supervisor, attendant, entrant.
2. Assure that there is at least one attendant outside the permit space, into which entry is authorized, for the duration of entry operations. The attendant may not monitor more than one confined space entry unless the Fermilab permit is amended to establish the means and procedures needed to enable the attendant to respond to one or more of the confined spaces.
3. The confined space entry team (i.e., entry supervisor, attendant, entrant) identifies and evaluates the hazards of the confined space before entry and indicates on the permit the potential hazards and protective measures needed. They include, but are not limited to:

Lockout/Tagout All energy sources which are potentially hazardous to confined space entrants shall be secured, relieved, disconnected and/or restrained as per FESHM Chapter 5120 before personnel are permitted to enter the confined space.

Pipelines or similar conveyances carrying any hazardous liquids or gases between the confined space and point(s) of isolation from any hazard shall be drained, cleaned or flushed of such materials as necessary to assure safety. The pipelines may be isolated by blocking, blinding or disconnecting.

NOTE: In confined spaces where complete isolation is not possible, provisions shall be made for as rigorous an isolation as practical. Provisions shall be noted on the entry permit.

Ventilation shall be maintained during the occupancy of a confined space where there is a potential for the atmosphere to move out of an acceptable range. Natural ventilation is acceptable if it is determined by the entry supervisor to achieve adequate results.

Personal protective equipment, i.e., gloves, coveralls, respirators, hard hats, footwear, etc. shall be available and required for use, when needed. Personal protective equipment needed for a confined space entry will be based on the work that will be accomplished and the hazard.

Appropriate retrieval equipment To facilitate entry and non-entry rescues, retrieval systems shall be used whenever an authorized entrant enters a permit space. This equipment typically includes a full body harness attached by a retrieval line to a mechanical retrieval device or to a fixed point outside the permit space. Exceptions exist to this requirement if the use of retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. All entrants are required to wear a full body harness, even if it is not attached to a retrieval line.

Hazardous Atmosphere Potential atmospheric hazards shall be identified before entry. These routinely include oxygen deficiency, flammability, carbon monoxide, and hydrogen sulfide. Other toxic chemicals are added as needed. The atmosphere must be tested before and during entry by the attendant to assure it is within acceptable limits. Monitor readings shall be recorded at a minimum of once an hour. Acceptable atmospheric limits for entry are:

- (i) Oxygen - 19.5% to 23.5% (separate requirements are applicable to designated oxygen deficiency hazard (ODH) areas in Chapter 5064).
- (ii) Flammability - Less than 10% of the Lower Explosive Limit (LEL).
- (iii) Toxicity - Carbon monoxide in a confined space is 25 parts per million (ppm) and hydrogen sulfide in a confined space is 5 ppm.

NOTE: Contact the Landlord ES&H Department or ES&H Section for limits on other toxic chemicals.

Barriers Barriers shall be in place to protect entrants from external hazards.

Welding/Burning/Brazing Permit The fire extinguishers required for this permit must be placed outside of the confined space. All permits must be issued by the Fire Department.

- 4. Entry supervisor assures all attendants and entrants are trained.
- 5. Entry supervisor informs authorized entrants and attendants of the required safety equipment and their proper use.
- 6. Entry supervisor verifies, by checking that the appropriate information has been entered onto the permit, that all tests specified on the permit have been conducted, and that all procedures and equipment specified by the permit are in place before approving the permit and allowing entry to begin.
- 7. The attendant performs air monitoring before entry and continuously during entry for atmospheric and other hazards associated with the confined space. As stated earlier, the attendant shall record monitoring results on the permit at a minimum of once an hour. The entrant(s) may also be required to perform continuous monitoring for the hazards associated with the confined space in the event that the attendant is unable to monitor the immediate vicinity of the workers within the confined space.
- 8. The entry supervisor shall authorize the permit before entry. A Landlord ES&H Department Senior Safety Officer or designee may be required to approve the permit before entry based upon the Landlord's internal written requirements. If a written approval is not practical, a verbal approval may be given and so noted on the permit.

9. The Landlord and Functional Landlord and Fire Department shall be notified prior to entry.
10. The entry supervisor determines, whenever responsibility for confined space entry operation is transferred to another entry supervisor, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.
11. The attendant must keep in constant communication with the entrant(s).
12. The attendant shall order the entrant(s) to evacuate the confined space immediately when there are:
 - a. Condition(s) which is/are not allowed in the permitted space.
 - b. Behavior effects of hazard exposure.
 - c. Any situation outside of the space which could endanger the entrants.
 - d. Sudden uncontrolled hazards within the confined space.
13. When the attendant orders an evacuation, the entry supervisor shall be notified and shall cancel the entry authorization. The entry supervisor shall notify the Landlord ES&H Department. Re-entry will not be permitted without the written approval of the Landlord ES&H Department Senior Safety Officer or designee.
14. In the event of an emergency, the attendant will contact the Emergency Operator. If a phone is immediately available, the Operator can be reached by dialing extension 3131 or 840-3131. If a phone is not immediately available, radio communications shall be used. It is imperative that the attendant never enters a confined space to attempt a rescue. In the event of a rescue situation, the attendant's main role shall be to summon help.

ENTRY PERMITS

Listed below are the requirements for filling out confined space entry permits when any Fermilab employee or scientific user (1) enters the space or (2) serves as entry supervisor.

1. The confined space team shall complete a permit. Additional check-off items may be added to the permit as needed.
2. The duration of the permit will be for the length of the job, so long as the conditions remain the same.
3. In the event that unacceptable conditions arise, the attendant will order an evacuation and inform the entry supervisor. The permit will be void, and a reevaluation will be required by the Landlord ES&H Department.
4. All significant identifiable hazards shall be listed on the permit.
5. If there is a shift change or multiple day jobs or change in entrants/attendants, a roster of entrants/attendants shall be attached to the permit if more space is needed.
6. Air monitoring records must be recorded on the permit.
7. All canceled confined space permits shall be retained by the division/section making the entry for a minimum of one (1) year.

CONFINED SPACE RECLASSIFICATION PROCESS

1. A space classified as a Permit-Required Confined Space may be reclassified as a Non-Permit Confined Space by an individual trained in confined space entry after the following provisions have been met:
 - a. No actual or potential atmospheric hazard exists (determined following initial atmospheric testing).
 - b. All other recognized serious safety or health hazards must be eliminated without entry into the space.

NOTE: If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed following permit-required confined space entry procedures. If testing and inspection during that entry demonstrates that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

- c. The basis for determining that all hazards have been eliminated must be documented using the Confined Space Reclassification Form from the ES&H Web-site.

NOTE: Reclassification status may be maintained for the duration of the entry as long as the hazards remain eliminated. In the event a change in conditions is identified or suspected by those working inside the space, the space shall immediately be vacated. The confined space will be considered a Permit-Required Confined Space until deemed otherwise through reevaluation.

2. All completed confined space reclassification forms shall be retained by the division/section making the entry for a minimum of one (1) year.
3. The Landlord and Functional Landlord and Fire Department shall be notified prior to entry.

TRAINING FOR CONFINED SPACES

Fermilab employees and scientific users who are designated as entry supervisors, entrants or attendants for confined space entries shall receive training (TRAIN class # FN000003-CR) prior to initial entry into a confined space. Additional training shall also be provided when a hazard for which an employee has not previously been trained or whenever there is reason to believe there are inadequacies in the employee's knowledge. All training records shall be entered into TRAIN.

Training shall include a review of:

1. The Fermilab Confined Space policy and procedures, as well as other applicable environment, safety and health procedures.
2. Hazards associated with confined space entry.
3. Signs and symptoms that may be present during or after an exposure to a hazard.
4. Consequences of exposure to potential hazards.

5. Methods of communication/contact.
6. When to initiate self-evacuation.
7. External safeguards that may be needed for safe entry.
8. Audio alarms and what the alarms mean (fixed alarms).
9. How to deal with unauthorized personnel.
10. Monitoring methods, techniques and instructions on the use of approved monitoring devices.
11. Emergency response procedures, i.e., exit when attendant instructs, when alarms are activated, call 3131 or 840-3131 for help, etc.
12. Proper method and procedure for completing the entry permit.
13. Justification for, and instructions on, the proper use and wearing of personal protective equipment.
14. Instructions on how a confined space is identified and classified.
15. Proper use of retrieval equipment (if applicable).

