



Permit Required Confined Space Training

**A 4-Hour Refresher
Training Class**

Confined Space

A space that:

- ⌘ 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 (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits); and
- ⌘ Is not designed for continuous employee occupancy.

Permit Required Confined Space

A confined space that has one or more of the following characteristics:

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

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 permit space), injury or acute illness from one or more of the following causes:

- ⌘ Flammable gas, vapor, or mist in excess of 10% of its lower flammable limit (LFL);
- ⌘ Airborne combustible dust at a concentration that meets or exceeds its LFL; (NOTE: Approximate condition where the dust obscures vision at a distance of 5 feet or less*);
- ⌘ Oxygen concentration below 19.5% or above 23.5%;

* "Rule-of-thumb" criteria for informational purposes only

Hazard Atmosphere (cont'd)

- ⌘ Concentration of any substance published in Subpart G, Occupational Health and Environmental Control, or Subpart Z, Toxic and Hazardous Substances, in excess of its dose or PEL. (NOTE: A concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.);
- ⌘ Any other atmospheric condition that is IDLH.

Immediately Dangerous to Life or Health (IDLH)

Any condition that:

- ⌘ Poses an immediate or delayed threat to life (NOTE: Effects of some toxic materials may be delayed 12-72 hours); or
- ⌘ Would cause irreversible adverse health effects; or
- ⌘ Would interfere with an individual's ability to escape unaided from a permit space.

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.

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.

Entry

- ⌘ The action by which a person passes through an opening into a permit-required confined space, and includes ensuing work activities in that space.
- ⌘ Considered to have occurred as soon as *any part of the entrant's body* breaks the plane of an opening into the space.

General Requirements

- ⌘ Employer decides if workplace contains a PRCS.
- ⌘ If workplace contains permit spaces, employer must inform employees of their existence and location and that they are dangerous.
- ⌘ If employer decides employees will not enter permit spaces, employer must positively ensure they do not.
- ⌘ If employer decides employees will enter permit spaces, employer shall develop and implement a *written* entry program.
- ⌘ Employer may use alternate entry procedures provided certain conditions and requirements are met.
- ⌘ When there are changes in use or configuration of a non-permit confined space that might increase the hazards to entrants, employer shall, if necessary, reclassify as a permit space.

General Requirements cont.

- ⌘ A permit space may be reclassified as a non-permit space:
 - ⊠ If there are no actual or potential atmospheric hazards and if all hazards within permit space are eliminated without entry, space may be reclassified for as long as the non-atmospheric hazards remain eliminated.
 - ⊠ If entry is required to eliminate hazards, it shall be according to regulations and space may be reclassified for as long as the hazards remain eliminated.
 - ⊠ Employer shall certify in writing that all hazards in permit space have been eliminated and make this document available to each entrant.
 - ⊠ If hazards arise in declassified permit space, employees shall exit and employer shall determine whether to reclassify space.

General Requirements cont.

- ⌘ When host employer arranges for contractor to perform permit space entry work, host employer shall:
 - ⊠ Inform contractor of permit space entry program;
 - ⊠ Apprise contractor of hazards of particular permit spaces and precautions and procedures implemented for protection of employees in or near permit spaces;
 - ⊠ Coordinate entry operations with contractor when both will be working in or near permit spaces and debrief contractor after entries.
 - ⊠ Contractors shall inform the host employer of the permit program to be followed and coordinate multiple entry operations.

Alternate Entry Procedures

Employer May use alternate entry procedures as specified in the regulation under certain conditions. If alternate entry procedures are used:

- ⌘ No formal written program [requirements in paragraph (c)(5)(ii) act as a substitute written program]
- ⌘ No permit system or permits [a written certification is required]
- ⌘ No attendant or supervisor
- ⌘ No rescue provisions
- ⌘ Training is required

Alternate Entry Procedures Conditions

- ⌘ Employer demonstrates that only hazard posed by permit space is actual or potential hazardous atmosphere.
- ⌘ Employer demonstrates that continuous forced air ventilation alone is sufficient to maintain safe permit space.
- ⌘ Employer develops monitoring and inspection data that supports above demonstrations.
- ⌘ If initial entry necessary to obtain above data, it shall be performed in accordance with this regulation.
- ⌘ Determinations and supporting data shall be documented by employer and made available to entrants.
- ⌘ Entry must be in accordance with requirements that follow.

Alternate Entry Procedures Requirements

- ⌘ Any conditions making it unsafe to remove an entrance cover shall be eliminated before removing cover.
- ⌘ When entrance covers are removed, opening shall be promptly and effectively guarded.
- ⌘ Before entry, internal atmosphere shall be tested with a calibrated direct-reading instrument, for the following conditions in the order given:
 1. Oxygen Content
 2. Flammable gases and vapors
 3. Potential toxic air contaminants

Alternate Entry Procedures Requirements (cont.)

- ⌘ There may be no hazardous atmosphere within the space whenever any employee is inside the space.
- ⌘ Continuous forced air ventilation shall be used as follows:
 - ⊠ Entry not permitted until hazardous atmosphere is eliminated;
 - ⊠ Ventilation shall be directed to immediate areas where employees are or will be present and continue until all employees have left space;
 - ⊠ Air supply shall be from a clean source and may not increase hazards in space.

Alternate Entry Procedures Requirements (cont.)

- ⌘ Atmosphere within space shall be periodically tested as necessary to ensure that ventilation is adequate.
- ⌘ If hazardous atmosphere is detected during entry:
 - ⊠ Each employee shall leave space immediately:
 - ⊠ Space shall be evaluated to determine how hazardous atmosphere developed; and
 - ⊠ Measures taken to protect employees from hazardous atmosphere before subsequent entry.
- ⌘ Employer shall certify in writing that space is safe for entry and that all of the above requirements have been met.
- ⌘ Certification to be available to each employee before entry

Permit Space Entry Program

- ⌘ Prevent unauthorized entry.
- ⌘ Identify and evaluate hazards before entry.
- ⌘ Establish safe practices, such as isolation, purging, inerting, ventilation, barricades, lockout/tagout, etc.
- ⌘ Provide and maintain equipment necessary for safe entry, including testing and monitoring, ventilation, communications, personal protection, lighting, barriers, ingress and egress, and rescue.
- ⌘ Test permit space and document results.
- ⌘ Maintain acceptable conditions in permit space.

Permit Space Entry Program

- ⌘ Provide at least one attendant outside permit space for duration of entry operations.
- ⌘ Identify duties of each employee and provide training.
- ⌘ Implement proper procedures for rescue.
- ⌘ Establish written system for preparation, issuance, use and cancellation of permits.
- ⌘ Coordinate entry operations during multiple employer entries.
- ⌘ Review entire entry program at least annually, unless previously reviewed at conclusion of a specific entry.

Permit System

- ⌘ The employer, through the permit system, shall:
 - ⊠ Complete and document all steps necessary for entry;
 - ⊠ Require initials or signature of persons completing the steps;
 - ⊠ Post permit at entry portal, or otherwise make available to all entrants at time of entry; and
 - ⊠ Ensure permit is signed by entry supervisor.

Permit System cont.

- ⌘ Duration of permit may not exceed time required to complete assigned task.
- ⌘ Permit must be cancelled if a prohibited condition arises, or the work has been completed.
- ⌘ Each cancelled entry permit must be retained for one year to facilitate program review.

Entry Permit



Identifies:

- ⌘ Permit space(s) to be entered
- ⌘ Purpose of entry
- ⌘ Date and authorized duration of entry permit
- ⌘ Authorized entrant(s)
- ⌘ Attendants
- ⌘ Entry supervisors, by printed name and signature
- ⌘ Hazards of the permit space
- ⌘ Measures required to control hazards of the space

Entry Permit cont.

- ⌘ Acceptable entry conditions
- ⌘ Test results with signature or initials of tester(s)
- ⌘ Rescue services, and the means to summon them
- ⌘ Communication procedures and equipment
- ⌘ All special equipment and procedures, including PPE and rescue equipment
- ⌘ Any other information needed to ensure safe entry
- ⌘ Any additional permits needed (such as for hot work)

Training



Employer shall provide and certify completion of training so that all affected employees acquire the understanding, knowledge, and skills necessary for the safe performance of assigned duties:

- ⌘ Before employee is assigned duties under this regulation;
- ⌘ Before there is a change in assigned duties;
- ⌘ Whenever employer has reason to believe either that there are deviations from permit space entry procedures or inadequacies in the employee's knowledge or use of these procedures

Duties of Authorized Entrants

Employer shall ensure that all authorized entrants:

- ⌘ Know the hazards that may be faced during entry, including mode, signs or symptoms, and consequences of exposure;
- ⌘ Properly use all required equipment;
- ⌘ Communicate with attendant as necessary to enable attendant to monitor status and alert entrants of need to evacuate.

Duties of Authorized Entrants

- ⌘ Alert attendant whenever any warning sign or symptom of exposure to a dangerous situation or a prohibited condition is detected.
- ⌘ Exit from permit space as quickly as possible whenever:
 - ⊠ Order to evacuate is given by attendant or entry supervisor;
 - ⊠ Entrant recognizes any warning sign or symptom of exposure to a dangerous situation;
 - ⊠ Entrant detects a prohibited condition; or
 - ⊠ Evacuation alarm is activated

Duties of Attendants



Employer shall ensure that each attendant:

- ⌘ Knows hazards that may be faced during entry;
- ⌘ Knows possible behavioral effects of hazards;
- ⌘ Continuously maintains accurate count of entrants;
- ⌘ Remains outside permit space during entry operations until relieved by another attendant;
- ⌘ Communicates with entrants as necessary to monitor status and alert of need to evacuate space;
- ⌘ Monitors activities inside and outside space to determine if safe for entrants to remain in space and orders evacuation when necessary.

Duties of Attendants cont.

- ⌘ Summons rescue and emergency services when emergency exit from permit space is necessary.
- ⌘ Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:
 - ⊗ Warns them to stay away;
 - ⊗ Advises them to exit immediately if they have entered; and
 - ⊗ Informs authorized entrants and entry supervisor if unauthorized persons enter space.

Duties of Attendants cont.

- ⌘ Performs non-entry rescues per employer's procedure;
- ⌘ Performs no duties that might interfere with their primary duty to monitor and protect authorized entrants.

Duties of Entry Supervisors

Employer shall ensure that each supervisor:

- ⌘ Knows hazards that may be faced during entry;
- ⌘ Verifies that acceptable conditions for entry exist;
- ⌘ Terminates entry when operations are completed or a prohibited condition arises;
- ⌘ Verifies that rescue services are available;
- ⌘ Removes unauthorized persons who enter or attempt to enter permit space during operations;
- ⌘ Determines, whenever responsible and at appropriate intervals, that acceptable entry conditions are maintained.

Rescue Services

- ⌘ Employer may elect to use on-site or off-site team.
- ⌘ If an on-site team:
 - ⊠ Must be properly trained in entry procedures, rescue procedures and PPE requirements;
 - ⊠ Permit space rescues must be practiced at least annually from similarly configured spaces;
 - ⊠ Must be trained in basic first-aid and CPR, and have at least one member currently certified.

Rescue Services cont.

⌘ If an off-site team:

- ⊠ Inform rescue service of hazards they may confront;
- ⊠ Provide rescue service with access to all permit spaces so they can develop appropriate rescue plans and practice rescue operations.

⌘ If injured entrant is exposed to substance with a required MSDS or similar document, it shall be made available to medical facility treating entrant.

Non-Entry Rescue

- ⌘ Retrieval systems or methods shall be used whenever entry is made, unless the retrieval equipment would increase overall risk of entry or would not be of value.
- ⌘ Each entrant shall use a chest or full body harness, with retrieval line attached at the center of their back near shoulder level, or above their head.
- ⌘ Wristlets may be used in lieu of the chest or full body harness if employer can show use of chest or body harness is infeasible or creates a greater hazard and that use of wristlets is safest and most effective alternative.

Non-Entry Rescue cont.

- ⌘ Other end of retrieval line shall be attached to a mechanical device or fixed point outside permit space for immediate use.
- ⌘ Mechanical device shall be used to retrieve personnel from vertical type permit spaces more than 5 feet deep.



Confined Space Hazards

Overview



III. Hazardous Atmospheres

- A. Asphyxiating atmospheres
- B. Flammable atmospheres
- C. Toxic atmospheres

IV. How Hazards Occur

- A. Previously stored products/chemicals
- B. Manufacturing process
- C. Operation/Work being performed
- D. Adjacent areas

V. Summary

Definitions of O₂ Deficient Atmosphere

<u>Source</u>	<u>Oxygen Content</u>
29 CFR 1910.146 (PRCS)	<19.5%
42 CFR Part 84 (NIOSH Rep Approval)	<19.5%
29 CFR 1910.134(g) (Resp. Std.)	16.0% ¹
29 CFR 1910.94 9Ventilaiton Std)	<19.5%
29 CFR 1915.11(b) (Shipyards)	<19.5%
ANSI Z117.1-1995 (Confinded Spaces)	<19.5%
ANSI Z88.2-1992 (Respirator Practices)	16.0% ²
ACGIH (TLV booklet)	18.0%

Definitions of O₂ Deficient Atmosphere

- ¹ Letter of interpretation
- ² Oxygen partial pressure <122 mmHg. Confined space with <20.9% O₂ is IDLH, unless source of O₂ reduction is understood and controlled.

Oxygen-Deficient Atmospheres

O ₂ Content	Effects and Symptoms (at P _{atm})
15-19%	Decreased ability to work strenuously. May impair coordination and induce early symptoms in persons with coronary, pulmonary, or circulatory problems.
12-14%	Respiration increases in exertion, pulse up, impaired coordination, perception, and judgement.
10-12%	Respiration further increases in rate and depth, poor judgement, lips blue
8-10%	Mental failure, fainting, unconsciousness, ashen face, blueness of lips, nausea, and vomiting.

Nitrogen (N₂)

⌘ Colorless, odorless inert gas

⌘ Slightly lighter than air

Argon (Ar)

⌘ Colorless, odorless inert gas

⌘ Heavier than air

Methane (CH₄)

- ⌘ Natural, marsh, swamp gas
- ⌘ Colorless, odorless flammable gas
- ⌘ Lighter than air
- ⌘ Toxic?
- ⌘ LEL = 5%; UEL = 15%

Carbon Dioxide (CO₂)

- ⌘ Colorless, odorless noncombustible gas
- ⌘ Heavier than air
- ⌘ Common in solid and compressed liquid forms
- ⌘ Carbonation
- ⌘ Inerting
- ⌘ Organic Decay (grain elevators, sewers, storage bins, wells)
- ⌘ Fermentation (digesters, molasses pit, beer and wine vats)

Carbon Monoxide (CO)

- ⌘ Colorless, odorless gas
- ⌘ Slightly lighter than air
- ⌘ Chemical asphyxiant
- ⌘ Primary source: incomplete combustion of organic material
- ⌘ Gasoline-fueled combustion engines

Concentration of CO Necessary to Produce Symptoms

Percent	Ppm	Effects
0.02	200	Possibly headache, mild frontal in 2-3 hours
0.04	400	Headache, frontal, and nausea after 1-2 hrs; occipital after 2-1/2 to 3-1/2 hrs
0.08	800	Headache, dizziness and nausea in $\frac{3}{4}$ hour, collapse and possible unconsciousness in 2 hrs.
0.16	1,600	Headache, dizziness and nausea in 20 min; collapse, unconsciousness. Possibly death in 2 hr.
0.32	3,200	Headache and dizziness in 5-10 min, unconsciousness and danger of death in 30 min
0.64	6,400	Headache and dizziness in 1-2 min, unconsciousness and danger of death in 10-15 min
1.28	12,800	Immediate effect; unconsciousness and danger of death in 1-3 min.

(Source: Hamilton & Hardy)

Symptoms of CO Exposure

Percent*	Symptoms
1-10	Shortness of breath on exertion
10-20	Tightness across forehead, slight headache
20-30	Throbbing headache
30-40	Severe headache, nausea, vomiting, collapse on exertion
40-50	All symptoms increased, pulse rate and breathing increased
50-70	Coma, interrupted breathing (Cheyne-Stokes), death`

*Percent saturation of Hemoglobin with CO (Blood Levels)

Hydrogen Sulfide (H₂S)

- ⌘ Sewer gas, stink gas (rotten eggs)
- ⌘ Odor threshold: 0.02 - 0.2 ppm
- ⌘ Colorless, flammable gas
- ⌘ Heavier than air

Effects of H₂S Concentration

ppm*	Local	Systemic
20		
50	Irritant of conjunctival and corneal epithelium	
50-100	Eye and respiratory tract irritation in 1hr.	
100-150		Slight systemic symptoms after several hours
150	Olfactory nerve paralysis	Fatal in 8-48 hours
200	Pulmonary irritation and pulmonary edema after prolonged exposure	Nervous system depression

*Concentration by Voume

Effects of H₂S Concentration

ppm*	Local	Systemic
250-350		Fatal in 4-8 hours
350-450		Fatal in 1-4 hours
500-600		Excitement, headache, dizziness and unconsciousness, death in 30-60 min
600-700		Rapid collapse, death in 2-15 min
700-2,000		Cessation of respiration, rapidly fatal

Lack of confined Space Training and Planning Cost Lives



The following statistics were compiled during an investigation of 39 workplace fatalities in 17 states caused by improper confined space entry

Confined Space Fatalities

- ⌘ 95% of all entries were authorized by supervisors
- ⌘ 85% of events were in the presence of a supervisor
- ⌘ 43% of victims were would be rescuers
- ⌘ 31% of companies with fatalities had written confined space entry procedures

Confined Space Fatalities

- ⌘ 29% of fatalities were supervisors
- ⌘ 15% of the fatalities had completed confined space entry training
- ⌘ None of the fatalities followed written procedures
- ⌘ None of the spaces was evaluated or tested prior to entry

Confined Space Fatalities

- ⌘ None of the spaces were ventilated
- ⌘ None of the companies suffering fatalities had a rescue plan

⌘ *Source: NIOSH, Division of Safety Research*