Confined Space Entry

Course Manual

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Confined Space Entry

Agenda

Introduction

Confine Spaces

Confine Space Hazards

Confine Space Videos

Lunch

Hazard Control

Monitoring Confine Spaces

Personnel Protective Equipment

Exam

Section 1

CONFINED SPACE

Purpose Statement
The purpose of “Confined Space’ is to describe the characteristic hazards associated with confined spaces. This includes procedures to follow for detecting and minimizing hazards prior to entering a confined space.

Regulation Application
“Confined Space’ complies with the following:

29 CFR 1910.146 (d) (3) states”...Develop and implement the means, procedures...”

29 CFR 1910 146 (c) (4) states “...written permit space entry program”

Confined Space Objectives

1. Discuss confined space classification.
2. List information required on confined space entry permits.
3. List hazards associated with confined spaces.
4. Explain isolation procedures.
5. List analytical instruments used to test confined space atmospheres.
6. Discuss procedures followed by personnel entering a confined space.

Background
There are approximately 2,000,000 confined space entries made in the United States each year. Statistics have shown on average this will result in 400 fatalities, most of these fatalities, would-be rescuers.

Confined Space Accidents
The following are examples of accident that might have been avoided if safety guidelines were followed:

A city worker was removing an inspection plate from a sewer line in a 50 foot deep pump station, when the plate blew off allowing raw sewage to enter the room. Two fellow workers and a policeman attempted to rescue the worker from the sludge filled room and were unsuccessful. All four were dead when removed from the pumping station.

A self-employed truck driver died after entering the top of a 22-foot x 15-foot square sawdust bin. He suffocated when the sawdust inside the bin collapsed and buried him.

A worker entered a septic tank to clean out the residue at the bottom and collapsed shortly afterward. Two workers on the outside went in to rescue the downed worker. All three workers died.

A self-employed plumbing contractor entered an underground water line vault to inspect a backflow device. The contractor collapsed shortly after entering the vault. A supervisor noticed the man down, and entered the vault in a rescue of the downed worker. Both were dead when removed from the tank, because of oxygen deficiency. Profile of Confined Space Accidents

Profile of Confined Space Accidents

The following lists many of the physical and chemical hazards of confined space entry.

I. Hazardous atmospheric conditions in the confined space resulting in an exposure to entrant, with adverse effects

2. Restricted entry/egress of the confined space.
3. ExplosIon/fire at the point of entry.
4. Falls inside the confined space.
5. Trapped in unstable material inside the confined space.
6. Explosion/fire inside the confined space.
7. Stress injuries from excess exertion
8. Struck by falling objects in the confined space.
9. Caught or crushed by material in the confined space.
10. Electrocution or shock in the confined space.
11 Heat burns while in the space.
12. Eye injuries during occupation of the space.

What is Confined Space?

I. Confined Space

This is an enclosed space that:

1. Is large enough and so configured that an employee can bodily enter and perform assigned work.
2. Has limited or restricted means for entry or exit (for example tanks, vessels, silos, storage bins, hoppers, vaults and pits').
3. Is not designed for continuous employee occupancy.

Permit Required Confined Space meets definition for a confined space **and** has one or more of the following characteristics:

- Contains or has a known potential to contain a hazardous atmosphere.
- May contain a material that has 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 winch slopes downward and tapers to a smaller cross-section.
- Contains any other recognized serious safety or health hazard.

Definition taken from 29 CFR 1910.146(b)

II. Typical Confined Spaces

tanks	pipelines	furnaces
diked areas	railroad tank cars	wells
tunnels	septic tanks	mixers
silos	holds of ships	culvert pipe
manhole	underground utility vaults	supply casings
storage stacks	equipment housings	storage elevators

smoke stacks	pits	vats
boiler	ducts	sewers
storage bins	barges	shafts
hoppers	Trenches	cisterns
cooling towers	autoclaves	tanker trailer
excavations	empty water tower	filtration vessels
vertical towers	process vessels	

III. Permit Required Confined Space Program

A confined space entry permit program is a written policy detailing how an employer manages its permitting system for entry into permit required confined spaces. The permit program should take into consideration the following:

- Employee training and awareness
- Hazard recognition
- Hazard evaluation
- Hazard control
- Protective equipment
- Rescue
- Contractors
- Restricting unauthorized entry

IV. Permit Requirements

1. The permit space to be entered.
2. The purpose of the entry.
3. The date and the authorized duration of the entry permit.
4. The authorized entrants within the permit space, by name or by such other means (for example. through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the duration of the permit which authorized entrants are inside the permit space.
5. The personnel, by name, currently serving as attendant.
6. The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry.
7. The hazard of the permit space to be entered.
8. The measures used to isolate the permits space and to eliminate or control permit space hazards before entry.
9. The acceptable entry conditions.
10. The results of initial and periodic tests performed under paragraph (d) (5) *(test space for acceptable entry conditions...monitor space to determine entry conditions remain consistent...test for oxygen, then combustible gases, then toxic gases)* accompanied by the names or initials of the testers and by an indication of when the tests were performed.
11. The rescue and emergency services that can be summoned and the means, such as the equipment to use and the number to call for summoning those services.
12. The communication procedures used by authorized entrants and attendants to maintain contact during the entry.

13. Equipment such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this section.
14. Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety.
15. Any additional permits, such as for hot work that have been issued to authorize work in the permit space.

V. Entry Supervisor

A. Definition:

An individual (such as the employer, foreman, or crew chief) responsible 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.

B. Duties and Responsibilities

The employer shall ensure that entry supervisors:

1. Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
2. Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.
3. Terminates the entry and cancels the permit as required by paragraph (e)(5) of this section.
   (i) The entry operations covered by the permit have been completed; or
   (ii) A condition that is not allowed under entry permit arises in or near the permit space
4. Verifies that rescue services are available and that the means for summoning them are operable.
5. Remove unauthorized individuals who enter or who attempt to enter the permit space during entry operations.
6. Determines whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

NOTE

Individuals empowered to authorize entries (Entry Supervisor) may also serve as Authorized Entrants or Attendants for an entry, if they have the proper training.

VI. Authorized Entrant

A. Definition:

An employee who is authorized by the employer to enter a permit required confined space. Authorized Entrants may rotate duties, serving as Attendants if the permit program and the entry permit so state. Any properly trained person with the authority to authorize entry by other persons may enter the permit space during the term of the permit provided the Attendant is informed of that entry.

B. Duties and Responsibilities

The employer shall ensure that all authorized entrants:

1. Know the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure.
2. Properly use equipment as required by paragraph (d)(4) of this regulation.

such as testing and monitoring equipment, ventilating equipment, communication equipment, personal protective equipment, lighting, barriers, ladders, rescue equipment other than that provided by rescue services and any other equipment needed for a safe entry.

3. Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by paragraph (i)(6) of this regulation. (Attendants duties #6)
4. Alert the attendant whenever:
   a) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or
   b) The entrant detects a prohibited condition
5. Exit from the permit space as quickly as possible whenever:
   a) An order to evacuate is given by the attendant or the entry supervisor.
   b) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.
   c) The entrant detects a prohibited condition or
   d) An evacuation alarm is activated.

VII. Attendant

A. Definition:

An individual stationed outside one or more permit spaces who monitors the Authorized Entrants and who performs all attendants duties assigned in the employers permit space program. An Attendant may monitor not more Entrants nor more permit spaces than the entry permit specifically authorizes.

B. Duties and Responsibilities:

The employer shall ensure that each attendant:

I. Knows the hazards that may be faced during entry, including information on the mode. signs or symptoms and consequences of the exposure.
2. Is aware of possible behavioral effects of hazard exposure in authorized entrants.
3. Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under paragraph (f)(4) of this section accurately identifies who is in the permit space.

tracking of entrants by name or by other such means (for example, through the use of a roster or tracking system as will enable the attendant to determine accurately, for duration of the permit, which authorized entrants are in space.)

4. Remains outside then permit space during entry operations until relieved by another attendant.
5. Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space.
6. Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions:
   a) If the attendant detects a prohibited condition.
   b) If the attendant detects the behavioral effects of hazard exposure in an authorized entrant.
   c) If the attendant detects a situation outside the space that could endanger the authorized

entrants.

d) If the attendant cannot effectively and safely, or perform oil the duties required under paragraph (i) of this section.

7. Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards.

8. Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

a) Warn the unauthorized persons that they must stay away from the permit space.

b) Advise the unauthorized persons that they must exit immediately if they have entered the permit space.

c) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

9. Performs non-entry rescues as specified by the employer's rescue procedure.

10 Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

VII. Rescue Situations

A. Attendant's Responsibilities:

1. Attendants must not enter the permit space to attempt rescue of entrants.

2. Attendants must be capable of using any rescue equipment provided for their use and perform any other assigned rescue and emergency duties, without entering the permit space..

B. Authorized Entrant's Responsibilities: Self-Rescue

1. The Entrant must exit the permit space when the Attendant orders evacuation.

2. The Entrant must exit the permit space when perceived dangers exist or automatic alarms are activated signaling dangers exist.

All authorized entrants must wear a chest or full-body harness when entering into a Permit required confined space.

A mechanical extraction device must be available on all vertical entries of greater than 5 feet in depth.

VII. Rescue Team

A. Definition:

The employer shall have either an in-plant rescue team or an arrangement under which an outside rescue team will respond to a request for rescue services.

B. In-Plant Rescue Team Duties and Responsibilities:

1. The employer shall ensure that the team has training on personal protective equipment and rescue equipment necessary for making rescues from the employer's permit spaces.

2. The team has received training up to the level of the Authorized Entrant.

3. Rescue teams practice making permit space rescues *at least once every twelve months*, by means of simulated rescue operations in which they remove dummies. Mannequins or personnel through representative openings and portals whose size, configuration and accessibility closely approximates those of the permit spaces from which rescues may be required.

4. At least *one* member of each rescue team maintain current certification in basic first aid and cardiopulmonary resuscitation (CPR) skills.

C. Outside Rescue Team:

If the employer chooses to use outside rescue services, the employer shall ensure that the designated rescuers are aware of the hazards they may confront when called on to perform rescues at the employer's facility, so that the outside rescue team can equip, train and conduct itself appropriately.

X. Contractors

Problems may arise when contractor personnel are required to perform work in permit required confined space. Contractors performing such work must be informed of all known and potential hazards related to the particular space, also any facility (host company) rules and emergency procedures.

Contractors must be required to work in accordance to either their own written confined space entry program (provided it meets regulatory requirements) or the entry requirements of the host company. Contractors should be required to furnish all equipment required for a safe confined space entry.

SECTION 2

Confined Space Hazards
Atmospheric

Hazardous Atmosphere:

An atmosphere which exposes employees to a risk of death. incapacitation, injury or acute illness.

A hazardous atmosphere has one or more of the following characteristics:

1. A flammable gas, vapor or mist in excess of 10% of its lower flammable limit (LFL).
2. An air borne combustible dust at a concentration that obscures vision at a distance of five feet (1 .52m or less).
3. An atmospheric oxygen concentration below 19.5% or above 23.5%.
4. An atmospheric concentration of any substance for which a permissible exposure limit is published in Sub-Part Z of 29 CFR 1910 and could result in employee exposure in excess of its permissible limit (s).

Oxygen Deficient

Definition: Less than 19.5% Oxygen

Causes of Oxygen Deficiency

a) Consumed
- Fire, Welding,
- Breathing
- Rusting
- Bacteria
- Fermentation

b) Displaced
- Purging w/inert gases (C02 - Nitrogen)
- Displaced by gas heavier than air (H2S)
- Displaced by natural gases such as Methane

c) Absorbption
- Grains
- Carbon (Activated Charcoal)
- Bacteria

Oxygen Enriched

Definition: Greater than 23.5% oxygen

Oxygen enriched atmospheres increase the potential for and intensity, in the combustion (fire) process.

Flammable

Definition Greater than 10% of Lower Explosive Limit

Causes of Flammable Atmosphere

a) Product
- Previously contained in space (Residue)
- Leaked into space (spill leaking pipes or hoses)
- Introduced into space (cleaning agents)

b) NATURAL
- Methane Gas produced in many confined spaces

c) COMBUSTIBLE DUSTS
- Sawdust
- Flour
- Other organic dusts or powders in sufficient quantity

Note: Many dust and powders have Explosive Limits. Visibility must not be obscured at five feet or less

Understanding Flammable Hazards

Fire/Explosion

1. Fire

a. Fire Tetrahedron
- Fuel
- Oxygen
- Heat
- Chemical Chain Reaction

b. Flammable vs. Combustible - The degree of fire hazard~posed by a certain chemical is measured according to its Flashpoint.

Flashpoint is the 'minimum temperature at which a substance generates sufficient vapor to form an ignitable mixture with air near its surface."

According to Department of Transportation (DOT) Regulations:

Flammable - A substance whose flashpoint is below 141°F.

- Examples of flammable liquid materials are alcohols (methanol), aromatics (benzene), and aiphatics (trichioroethane).
- Examples of flammable solid materials are dusts of magnesium, aluminum, zinc and phosphorus.
- Water reactive chemicals that may cause fires are lithium, sodium and potassium.
- Some chemicals may also react in air (pyrophoric) and cause fires, such as dimethyl zinc and tributyl aluminum.

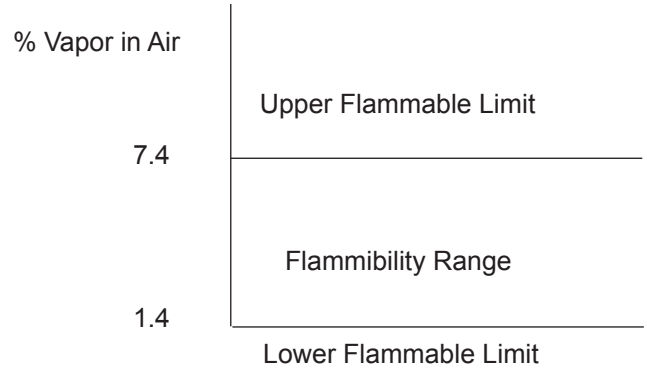
Combustible - A substance whose flashpoint is 142°F or higher. Non-liquid materials such as wood and paper are classified as ordinary combustibles.

c. **Vapor Density** - Defined as: "The weight of a vapor or gas compared to the weight of an equal volume of air." Materials heavier than air have a vapor density greater than 1.0. Combustible and flammable liquids generate vapors that are heavier than air (i.e. VAPOR DENSITY> 1.0).

d. **Flammable Limits** - Defined as: "The minimum and maximum concentrations of a vapor or gas between which ignition can occur. Concentrations below the Lower Flammable Limit (LFL) are too lean to bum. While concentrations above the Upper Flammable Limit (UFL) are too rich to burn."

e. Explosive Limits - The minimum and maximum concentrations of a gas or vapor between which an explosion can occur. Upper and Lower Explosion Limits (UEL and LEL) are equivalent to the UFL and LFL values.

Typical site hazard areas where explosion risks may occur are drums, tanks, silos, sewers, vaults, trenches and excavations.



Gasoline

Chemicals providing potential for explosion pockets of methane gas. nitrogen compounds and ignitable vapors in confined spaces.

Toxic

Definition: Contains an concentration in excess of the OSHA Permissible Exposure Limit. (PEL)

Causes of Toxic Atmosphere

a) PRODUCT

- Previously contained in space (Residue)
- Leaked into space (spill, leaking pipes or hoses)
- Introduced into space (cleaning agent. pest control)

b) NATURAL AND BIOLOGICAL

- Hydrogen Sulfide (H2S)
- Bacteria
- Insects
- Parasites (ticks. fleas. chiggers)

Understanding Toxic Hazards

Routes of Exposure

A. Toxic Responses

1. **Local** response to chemical exposure which is evidenced at the site of the exposure itself (e.g. a skin rash which develops when a chemical is rubbed on the skin).
2. **Systemic** response to chemical exposure which is evidenced in areas other than the area of direct exposure to repeated consumption of ethyl alcohol leading to cirrhosis of the liver). The area or organ that is affected by the chemical exposure is generally known as the target organ.

B. Entry Into The Body

Chemicals have several ways that they can enter the body. These ways include:

1. **ingestion** - intake of a chemical through the mouth into the digestive tract (e.g., eating or drinking a chemical).
2. **inhalation** - breathing in a chemical.
3. **absorption** - intake of a chemical through the skin.
4. **injection** - intake of a chemical by puncture of the skin.

C. Action of Toxic Substances

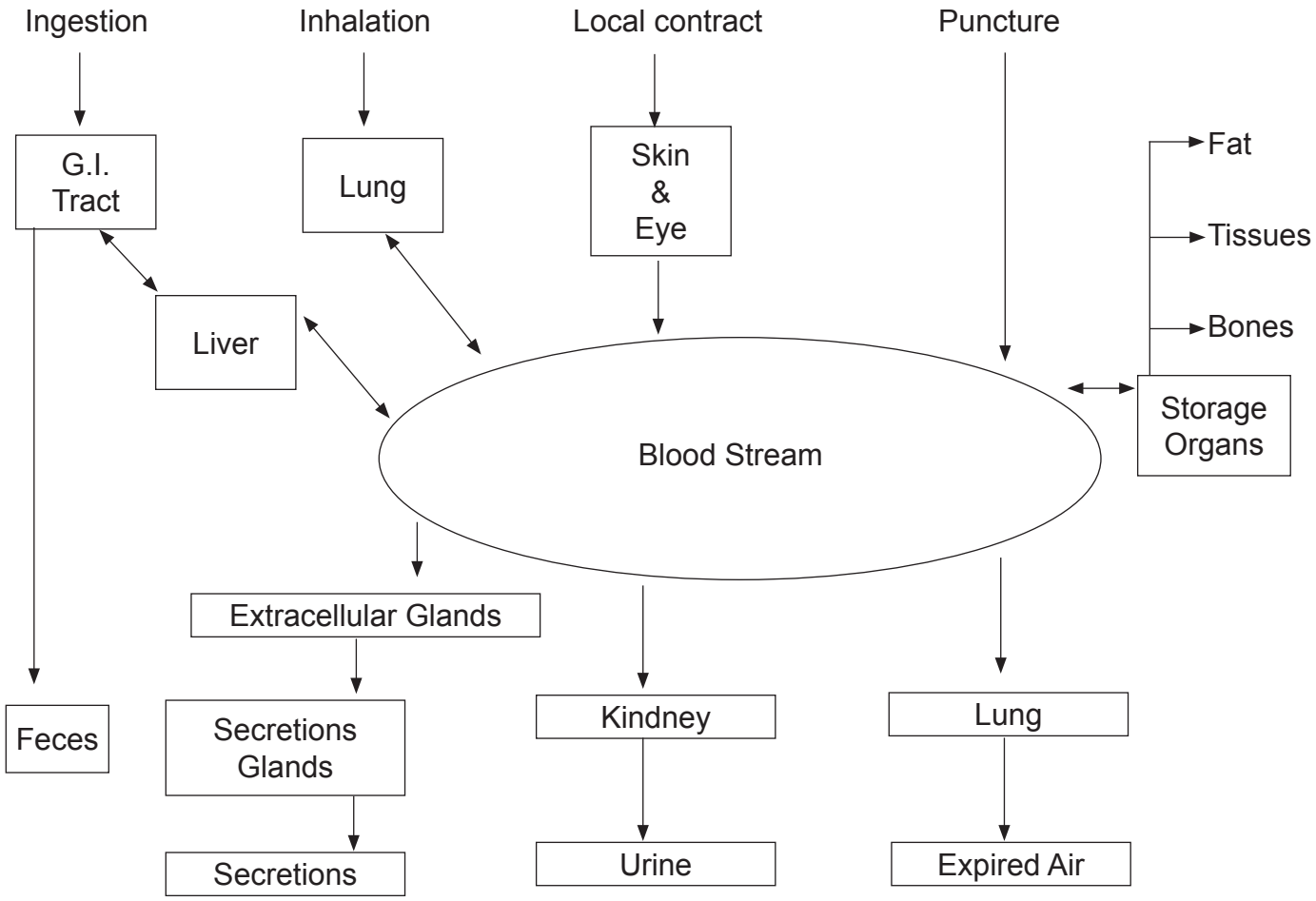
1. **Acute Effect**

Result from short term exposure to high concentrations with relatively immediate effects. Exposure may be instantaneous or can occur over a 24 hour period. Acute effect is characterized by rapid absorption of the substance with minor to devastating effects that are usually over within a short time. An exception would include agents that cause death. teratogemc effects, niutagemc effects and/or cancer.

2. **Chronic Effects**

Result from repeated or continuous exposure to a chemical over long periods of time (90 days,

Routes Of Entry, Distribution and Excretion



Excretion

greater than a year or a lifetime). Injuries may result from a constant level of the toxicant in the body, accumulation in body system. or accumulation of damage to the body. Within the category of chronic effects there are several responses the body can exhibit with regard to these chronic exposures.

Physcial

Space Configuration
- Baffles
- Drop-offs

Engulfment
- Solids (Powders - soils)
- Liquids
- Sludges

Temperature Extremes
- Heat Stress
- Cold Stress
- Rapid changes in temperature

Moving Parts
- Agitators
- Paddles
- Belts
- Rollers

Converging wails or floors
- Tapered Walls or floors leading to smaller cross sections which may trap entrant.

Electrical shock
- Energized Equipment
- Wires, Subpanels, Control boxes

Poor Lighting
- Most Confined Spaces have inadequate natural illumination. If artificial lighting is to be introduced into the space it should be type necessary for safe operations (intrinsically safe).

Lack of communication
- Space size or configuration
- Echoing
- Normal work noises intensified Slips, Trips and Falls
- Entering - Exiting
- Uneven footing
- Poor footing Animal/Pests
- Rodents
- Snakes

External Hazards

Consideration must be made for any of the conditions noted in the *Hazards* section that may be present *outside* the space that could possibly interfere or effect operations in the permit space Also any other condition *outside* that may endanger individuals working in or around the permit space.

SECTION 3

Hazard Control

I. **Ventillation**

A. ***Natural Ventilation:*** ventilation which is solely dependent on the movement of air without assistance. This method is inadequate for most confmed space.

B. ***General ventilation:*** is an effective procedure for distributing contaminants from a local generation point throughout the work space to obtain maximum dilution below the concentrations of contaminants specified in 29 CFR Part 19 10.1000 Sub-Part Z. Both Supply and Exhaust ventilation are considered General ventilation since they work on the principle of air exchange.

C. ***Supply Ventilation:*** ventilation in which air is pushed into the space mechanically, forcing contaminated air to exit through any available opening. With this type of ventilation caution must be taken to assure that there is sufficient openings in number or size to allow contaminated vapors/air to exit space.

D. ***Exhaust Ventilation:*** ventilation that utilizes a mechanical fan or ejector to pull contaminated air from the space. Replacement air is then pulled into the space through any available openmg With this type of ventilation caution must be to assure that there are sufficient openings to allow an equal exchange of contaminated air to be replaced with fresh air.

E. ***Local exhaust ventilation:*** shall be provided when general ventilation is not effective due to restrictions in the confined space or when high concentrations of contaminants occur in the breathing zone of the worker.

Ventilation Exhausts: With any type of ventilation from a confined space. the location of the discharge of exhausts, of the ventilation process must be a consideration. In order to accomplish this in a controlled manner the use of ducts or trunks is sometimes necessary. The diameter of the ducting and the number of bends or turns will effect the efficiency of your ventilation process.

II. Electrical and Mechanical (lock-out / tag out)

A. ***Electrical isolation*** of the confined space to prevent accidental activation of moving parts that would be hazardous to the worker is achieved by locking circuit breakers and/or disconnects in the open (off) position with a key-type padlock. A tag should also accompany the lock on the circuit breaker.

B. ***Mechanical isolation*** of moving parts can be achieved by disconnecting linkages or removing drive belts or chains. Stored or residual energy from power sources such as pneumatic or hydraulic must be released.

III. Product Isolation

1. *Blanking or Blinding:* The absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
2. *Double Block and Bleed:* The closure of a line, duct or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
3. *Disconnect* The intentional removal of sections or the misaligning of pipings or ducts.

IV. Labeling and Posting

All warning signs shall be printed both in English and in the predominant language of non-Engiish reading workers. Where established symbols exist, they shall also be used. Workers unable to read labels and posted signs shall receive information regarding hazardous areas and shall be informed of the instructions printed on the signs. All entrances to any confined space shall be posted.

Signs shall include but not necessarily be limited to the following information:

DANGER
CONFINED SPACE
ENTRY BY PERMIT ONLY

Add this information if conditions warrant posting:

1. **Respirator required for entry**
2. **Retrieval line required for entry**
3. **Hot work required**
4. **No hot work permitted**

Barriers

Physical barriers and warning signs outside the confined space increase awareness of personnel working in close proximity of the permit space and are a method of controlling external hazards which may impact operations within the space

Examples:	Cones	Warning Signs
	Barrier Tape	Flashing Lights
	Rope	Warning Flags
	Sawhorses	Manhole Guard
		Security Person

V. Elimination of Fire and Explosion Hazards

Vapors or Gases

Vapors or gases in a permit required confined space above the allowable concentration (10% LEL) may be lowered by;

I. ***Venting:*** The introduction of air into the space for the purpose of diluting the atmosphere of vapors or gases which produce monitoring results greater than the maximum allowable concentration of 10% Lower Explosive Limit.

2. ***Inerting:*** The displacement of the atmosphere in a permit space by a non combustible gas (such as nitrogen to such an extent that the resulting atmosphere is non combustible. *Note: This procedure produces as IDLH oxygen-deficient atmosphere.*

3. ***Flushing:*** Rendering the atmosphere of a permit space non-flammable , non-explosive or otherwise chemically non-reactive by such means as washing the inside of the permit space with a compatible substance and then removing the compatible substance to conduct work in the permit space.

Static Electricity:
A spark generated by static electricity can have sufficient energy to ignite flammable or explosive gases vapors or dusts

1. Grounding and bonding eliminates a difference in electrical potential between a container and the earth. Grounding wires must be connected to known grounds like gas pipes or water pipes and grounded metal building framework.
2. Prevention of fire or explosion involves recognizing the hazard and taking appropriate steps. This includes using equipment to detect an explosive or flammable atmosphere and using equipment: for example. explosion proof instruments and non-sparking bronze, brass or aluminum tools
3. Items that can also generate a spark are: beepers. money/change ín the pocket, and a metal belt buckle.

Section 4

Atmosphere Monitoring Instruments

The testing of atmospheric conditions within the permit required confined space are required by the standard and must be considered prior to entering the space and during the entire entry operating. Caution must be taken upon opening a sealed confined space as to prevent any exposure to the individual performing the pre-entry testing.

Monitoring required for detection in three specific categories:
Oxygen Percentage in the Space
Percentage of lower explosive limit
Level of toxic concentration

I. Monitoring Instruments

A. Oxygen Meter (O2 Meter)

1. ***Principle of operation*** Oxygen molecules diffuse through a semipermeable membrane electrochemical sensor. Reaction between the oxygen and the produces a current proportional to the oxygen content in the air sample.
2. ***Limitations***
    a) Must be calibrated to compensate for altitude and barometric pressure
    b) Detector cell can be poisoned by the Carbon Dioxide
    c) The present of strong oxidizing chemicals like ozone and chlorine may cause increased meter response.

B. Combustible Gas Indicator (LEL Meter)

1. ***Operating Principle*** Combustible gas or vapor is drawn across a hot platinum filament which is integral part of a resistor circuit called a Wheatstone Bridge. The hot filament burns the gas, thus raising the temperature increase produces a resistance imbalance which is measured as a percentage of the LEL.
2. ***Limitations***
    a) Does not provide valid reading under oxygen deficient conditions.
    b) Filament can be damaged by certain compounds such as silicones, leaded gas, and halides.
    c) Sensitivity is based on differences between the calibration gas and the gas being sampled.

C. Photoionization Dector

1. ***Operating Principle*** Ionizes organic and some inorganic molecules using ultraviolet radiation. The charged particles produce an electric current which is proportional to the number of ions present.
2. ***Limitations***
    a) Does not detect inorganic gases or vapors
    b) Sensitivity depends on the compound
    c) Should not be used at temperatures less than 40ºF.
    d) Difficult to absolutely identify compounds.

D. Flame ionization Detector

1. ***Operating Principle*** Organic gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present.
2. ***Limitations***
    a) Does not detect inorganic gases and vapors.

b) Sensitivity depends on the compound
c) Should not be used at temperatures less than 40ºF
d) Difficult to absolutely identify compounds.

E. Direct-Reading Colorimetric Indicator Tubes

I. ***Operating Principle*** Compound reacts with the indicator chemical in the tube, producing a stain whose length of color is proportional to the compound's concentration. Which in turn is calculated on the numerical graduation on the tube.

2. ***Limitations***

a) Interference from similar chemicals.
b) Tubes have limited shelf life.
c) Readings are open to operator judgment.
d) Affected by high humidity.
e) Slow response time.

II. Calibration

The calibration of monitoring equipment is crucial in so far as the calibration procedure assures that the instrument is functioning properly, and will give an accurate reading to the conditions present within a permit required confined space.

Most calibration procedures are instrument specific and should be performed by an individual who is both familiar with the instrument and has been trained in the proper procedure for the calibration of each meter type/model that they may be responsible for calibrating.

Other concerns about instrument operation other than current calibration are:

Fully charged power supply (battery status)
All components present (sampling hose. probe auachments. etc.).
Instrument condition (clean, check for cracks, chips or other damage to meter housing).
Functional check (turn meter on, warm up, check responses in clean atmosphere.

III. Sampling Sequence

The order in which sampling of the atmosphere is conducted is as follows.

I. Check Oxygen concentration first. Oxygen is not only essential for sustaining life but must be present in order to assure accurate reading of a Combustible Gas Indicator (LEL METER). Combustible Gas readings in less than 10 -15 % oxygen should be suspect.

Safe Range - 19.5% to 23.5% Oxygen in atmosphere.

2. Check LEL concentration.

Safe Range - less than 10% Lower Explosive Limit.

3.. Check TOXIC concentration.

Safe Range - Below published Permissible exposure Limit (PEL) or Threshold Limit Value (TLV).

SECTION 5

Personal Protective Equipment

Purpose Statement

The purpose of "Personal Protective Equipment" is to familiarize the participant with equipment that will eliminate hazards related to exposures of potentially harmful substances while working in or around Permit Required Confined Spaces.

Regulation Application

"Personal Protective Equipment" complies with the following
29 CFR 1910.146 (d) (4) (iv) states:

"*...Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees...*"

Respiratory Hazards

I. Normal Atmosphere

Contains:

78% nitrogen
21% oxygen
0.9% inert gases
0.04% carbon dioxide

II. Respiratory Hazards

A. Oxygen Deficiency

% Oxygen	Effect
21-16	Nothing unusual.
16-12	LOSS of peripheral vision, increased breathing volume, accelerated heart rate, impaired thinking.
12-10	Very faulty judgment. very poor muscular coordination, fatigue. heart damage.
10-6	Nausea& vomiting, loss of movement, unconsciousness
<6	Convulsions, death in minutes.

19.5% oxygen lowest safe limit for hazard Confined Space work.

B. **Aerosols** - fine particulates (solid or liquid) suspended in air. Aerosols can be classified by their physical form and origin and by their physiological effect on the body.

1. Entrapment of particles in the respiratory system.
   a) 5-30 microns - deposited in the nasal and pharyngeal passages.
   b) 1-5 microns - collected in the trachea and bronchi.
   c) <0.5 microns - diffuse from bronchioles into the alveoli.

2. Physical Classifications.
    a) Spray - visible liquid dispersoid.
    b) Fume - extremely small solid condensation dispersoid.
    c) Mist - Liquid condensation. d. Fog - mist dense enough to obscure vision.
    e) Smoke - liquid or solid organic particles resulting from incomplete combustion.
    f) Smog - mixture of smoke and fog.
3. Physiological Classifications.
    a) Nuisance - no lung injury but proper lung functioning inhibited.
    b) Inert pulmonary reaction - causing non-specific reaction.
    c) Pulmonary fibrosis - causing effects ranging from nodule production in lungs to serious diseases such as asbestosis.
    d) Chemical irritation - Irritation. inflammation or ulceration of lung tissue
    e) Systemic poison - diseases in other parts of the body.
    f) Allergy-producing - causes allergic hypersensitivity reactions such as itching or sneezing.

C. **Gaseous Contaminants** - molecular sized gases and vapors which may diffuse into the respiratory tract and be absorbed into the blood stream. Contaminants are classified chemically and physiologically.

1. ***Chemical Classifications***
    a) Acidic - acids or substances which react with water to form acids.
    b) Alkaline - bases or substances which react with water to form bases.
    c) Organic - compounds which may range from methane to chlorinated organic solvents.
    d) Organometailic - organic compounds containing metals..
    e) Hydrides - compound in which hydrogen is bonded to another metal.
    f) Inert - no chemical reactivity.
2. ***Physiological Classifications***
    a) Irritants - corrosive substances which injure and inflame tissue.
    b) Asphyxiants - substances which displace oxygen or prevent the use of oxygen in the body.
    c) Anesthetics - substances which depress the central nervous system, causing a loss of sensation or intoxication.
    d) Systemic poisons - substances which can cause disease or injury in various organ systems.

III. Classes of respirators

A. Air Purifying Respirators - designed to remove contaminants by passing the inhaled air through a purifying element. Filtration is achieved by one of two types of purifying cartridges; can be used only in an atmosphere containing $\geq$ 19.5% oxygen.

Types of Cartridges:

    a) Mechanical Filter (aerosols). b Chemical Sorbents (gases and vapors)
    b) Atmospheric Supplying Respirators - provide a substitute source of clean breathing air: can be used regardless of type of contaminant or oxygen concentration

Types of Atmosphere Supplying Respirators:

    a) Self-Contained Breathing Apparatus (SCBA)
    b) Supplied Air Respirators.

C. Respiratory Program

Minimal Acceptable Program:
a) Written standard operating procedures governing the selection and use of respirators shall be established.
b) Respirators shall be selected on the basis of hazards to which a worker is exposed.
c) The user shall be instructed and trained in the proper use of respirators and their limitations.
d) Respirators shall be regularly cleaned and disinfected. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use.
e) Respirators shall be stored in a convenient, clean and sanitary location.
f) Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced.
g) Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.
h) There shall be regular inspection and evaluation to determine the continued effectiveness of the program.
i) Persons should not be assigned to tasks requiring use of respirators unless it has been determined by a physician that they are physically capable.

Air Purifying Respirators

I. Introduction

Air Purifying Respirators (APR's) provide protection by removing contaminants by passing the breathing air through a purifying element Air Purifying Respirators are composed of two main parts. The facepiece is one of the two major components of an air-purifying respirator the air purifying element is the other.

II. Respirator Types

The protection provided the respirator wearer is a function of how well the facepiece (mask) fits. No matter how efficient the purifying element there is little protection afforded if the respirator mask does not provide a leak-free facepiece-to-face seal Facepieces are available in three basic configurations.

A. **Quarter-Mask** fits over the bridge of the nose, along the cheek, and across the top of the chin Limited protection is expected because the respirator can be easily dislodged. creating a breach in the seal

B. **Half-Mask** fits over the bridge of the nose, along the cheek, and under the chin. Because they maintain a better seal and are less likely to be dislodged, half-masks give greater protection than quarter-masks

C. **Full-Facepiece** fits across the forehead, down over the temples and cheeks, and under the chin. These masks give the greatest protection because they are held in place more securely and because it is easier to maintain a good seal along the forehead than it is across the top of the nose An added benefit is the eye protection from the clear lens uithe full-facepiece

III. Facepiece Limitations

A. **Protection Factor (PF)** - A measure of relative protection offered by a respirator, ratio of contaminant concentration inside the facepiece to that outside the mask. The protection factor is 10 for a quarter-mask and half-mask respirator and 50 for a full-facepiece respirator.

B. **Maximum Use Limit (MUL)** - The highest concentration, not exceeding IDLH concentration, of a specific contaminant in which a' respirator can be worn.

IDLH: Immediately dangerous to life and 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 individuals ability to escape unaided from a permit space.

IV. Air Purifying Elements

Respiratory hazards can be broken down into two classes: particles and vapors/gases. Particulates arc filtered by mechanical means, while vapors and gases are removed by sorbents that react chemically with them. Respirators using a combination of mechanical filter and chemical sorbent Will effectively remove both hazards.

A. Particulate-Removing Filters

1. ***Dust Filter:*** Efficiency of 80-90% for 0.6 micron particles.
2. ***Fume Filter:*** Efficiency of 90-99% for 0.6 micron particles.
3. ***High Efficiency Particulate Air (HEPA) Filter:*** 99.97% effective against particles 0.3 microns in diameter.

B. Gas and Vapor-Removing Cartridges and Canisters

When selecting a gas or vapor-removing element it must be chosen for protection against a specific type of contaminant. Some of the commonly employed types of chemical cartridges and canisters and their OSHA required color coding are listed below.

Chemical Cartridge and Canister Types and Color Coding

Atmospheric contaminants to be protected against	***Colors assigned***
Acid gases	White
Hydrocyanic acid gas	White with 1/2 inch green suipe completely around the canister near the bottom
Chlorine gas.....	White with 1/2 inch yellow stripe completely around the canister near the bottom
Organic vapors.....	Black
Ammonia gas.....	Green
Acid gases and ammonia gas.....	Green with 1/2 inch white stripe completely around the canister near the bottom
Carbon monoxide.....	Blue
Acid gases and organic vapors.....	Yellow
Hydrocyanic acid gas and chloropicrin vapor.....	Yellow with 1/2 inch blue stripe completely around the canister near the bottom
Acid gases, organic vapors, and ammonia gases	Brown
Particulates (dusts. fumes, mists, fogs or smokes).....	Purple (magenta).

1. ***Style and Size*** Gas and vapor canisters are available in different styles and sizes. The smallest elements are canisters which contain 50-200 cm^3 of sorbent and are attached to the facepiece. usually in pairs. Chin canisters have a volume of 250-500 cm^3 and are attached to a full-facepiece.

2. ***Service Life*** Each sorbent has a finite capacity for removing contaminants and when this limit is reached the cartridge or canister is said to be saturated. The length of time a cartridge or canister will effectively adsorb the contaminant is known as the service life of the element. Service life of a type of cartridge or canister is dependent on the following:

a) *Breathing Rate* - If the breathing rate of the user is rapid, the flow rate of the contaminated air drawn through the cartridge is high. A higher flow rate brings a larger amount of contaminant in contact with the sorbent in a given period of time which, in turn, increases the rate of sorbent saturation and shortens service life.

b) *Contaminant Concentration* - As concentration goes up, more contaminant comes in contact with sorbent in a given period of time. For example. at any constant breathing rate, ten times as much contaminant contacts the element when the concentration is 500 ppm compared to 50 ppm.

c) *Cartridge Efficiency* - Chemical sorbents vary in their ability to remove contaminants from air. The efficiency of the canister is determined from the chemicals physical properties of the contaminant. The efficiency of organic vapor cartridges for solvents is compared by recording the arc time a 1% breakthrough concentration is measured in the cartridge filtered air.

3. ***Warning Properties*** A warning property is a sign that a cartridge or canister in use is beginning to lose its effectiveness. A warning property can be detected as an odor, taste or irritation . At the first such signal. the old cartridge or canister must be exchanged for a fresh one. A material has adequate warning properties if the effects (odor, taste. irritation) are detectable and persistent at concentrations at or below the Permissible exposure limit or Threshold limit values (PELTI1V).

Permissible Exposure Limit or Threshold Limit Value (PELTftV). The maximum concentration of a material to which workers can be exposed over an eight hour day, day after day, without adverse effects.

V. Respirator Selection Criteria

Air Purifying Respirators should be used only when the following conditions have been met.

1. Identity and concentration levels of the contaminant are known.
2. Oxygen content is at least 19.5%.
3. Respirator assembly is approved for protection against the specific contaminant and concentration level. This includes an analysis to determine...
   - that the service limits of the cartridge/canister are not exceeded.
   - that adequate warning properties exist for the contaminant.
   - that the concentration does not exceed IDLH levels.
   - that the maximum use concentration for the particular type of cartridge is not exceeded.
4. Periodic monitoring of the work area occurs.
5. Wearer has been successfully fit tested with that type of respirator.

VI. Respirator Donning

1. Always make sure all respirator parts are present before donning.
2. Place respirator over face and draw straps securely.
3. Secure bottom straps first.
4. Mask should not be so tight as to cause headache.

5. Conduct negative and positive pressure tests

All users of air purifying respirators should be fit tested to ensure a proper facepiece-to-face seal. Respirators shall not be worn when conditions prevent a good face seal (i e beard sideburns, eyeglasses).

Negative and Positive Pressure Test:

This test is used as a gross determination of fit. The wearer should use this test just before entering the hazardous atmosphere

VII. Respirator Cleaning

1. Remove all cartridges canisters, and filters, including gaskets and seals not affixed to their seats
2. Remove elastic straps.
3. Remove exhalation cover
4. Remove inhalation and exhalation valve assembly 5 Wash in sanitizing solution
6. Remove all parts from the wash water and rinse twice in clean warm, water
7. Air dry parts in a designated clean area.
8. Wipe facepieces, valves, and seats with a damp cloth to remove any remaining fling soap or foreign material.

Atmosphere Supplying Respirators

I. Introduction

If the requirements for using air purifying respirators cannot be met, then an atmosphere supplying respirator is required.

II. Types of Atmosphere Supplying Respirators

A. *Air Line Respirator* - air is delivered to the wearer under pressure; either from a compressor or a bank of compressed air cylinders. No more than 300 feet of airline is allowed. An escape device is required for entry into an IDLH atmosphere.

B. *Self-Contained Breathing Apparatus* - (SCBA) consists of a facepiece and regulator mechanism

III. Mode of Operation

Pressure-Demand

An SCBA or Airline respirator operating in the pressure- demand mode maintains a positive pressure inside the facepiece at all times. The pressure in the facepiece is greater than the ambient pressure outside the facepiece. If any leakage occurs, it is outward from the facepiece protecting the wearer from having harmful substances entering the face piece. Because of this, the pressure-dam- and SCBA has been assigned a protection factor of 10,000.

IV. Types of Apparatus

A. *Closed-Circuit (Rebreather)*

The closed-circuit SCBA:

- recycles exhaled breath.
- mixes oxygen with exhaled breath. from which carbon dioxide is removed.
- operates in both demand and pressure-demand mode.
- uses either compressed oxygen or liquid oxygen.

B. *Open-Circuit* -The open-circuit SCBA requires a supply of compressed breathing air The user simply inhales and exhales The exhaled air is exhausted from the system

V. Components of an Open Circuit Pressure Demand SCBA

A. *Cylinder* - A maximum of 45 cubic feet of Grade D air at a pressure of 2,216 pounds per square inch (psi) is needed for a 30-minute supply Cylinders are also available in a high pressure (4500 psag) model These bottles are either rated 30 minutes or 60 minutes depending on the total cubic feet at air in each.

A hydrostatic test must be performed on a cylinder at regular intervals: For steel cylinders, every 5 years; for composite cylinders (glass fiber/aluminum), even 3 years.

B. *High-Pressure Hose* - The high-pressure hose connects the cylinder and the regulator

C. *Alarm* - A low-pressure warning alarm is also located near the I connection to the cylinder. This alarm must sound when 75-80% of the air supply has been consumed to alert the wearer that only 20-25% is available for retreat.

D. *Regulator Assembly* - Air travels from the cylinder through the high-pressure hose to the regulator there it can travel one of two paths. If the by-pass valve is opened, air travels directly through the breathing hose into the facepiece. If the mainline valve opened, air passes through the regulator and is controlled by that mechanism.

Under normal conditions, the bypass valve is closed and the mainline valve opens so air can enter the regulator. Once in the regulator. the air pressure reduced from the actual cylinder pressure to approximately 50-100 psi by reducing mechanism.

E. *Breathing Hose and Face piece* The breathing hose connects the regulator to the facepiece. Above the p the mask where the hose is connected is a check valve. This valve allow to be drawn from the hose when the wearer inhales, but prevents exhaled air from entering the breathing hose. I

F. *Back-Pack and Harness* A back-pack and harness support the cylinder and regulator, allowing the user to move freely. Weight should be supported on the hips not the shoulders.

VI. Inspection and Checkout

The SCBA must be inspected according to manufacturers' guidelines, as well as 29 CFR recommendations. In addition. the SCBA should be checked out immediately prior to use. Checkout and inspection procedures should be followed closely to assure safe operation of the unit.

Note: Although all Self Contained Breathing Apparatus have the same basic components, the configuration of valves, alarms and donning procedures can vary from manufacturer to manufacturer. Users or potential users must be familiar with the configuration of the make. model and style of SCBA available to them

Personal Protective Clothing and Gloves

I. Purpose

To shield or isolate an individual from the chemical, physical. or biological hazard that may be encountered during a confined space entry. The predominant properties of the hazards determine the type and degree of protection required. PPE ensembles range from safety glasses, bard bats, and safety shoes up to chemical resistant clothing, respiratory protection full body harness, lifeline and extraction device.

NOTE: No single combination of protective equipment and clothing is capable of protecting against all hazards.

II. Performance Requirements

Chemical Resistance - Will clothing maintain its structural integrity and protective qualities?

Strength - Is material resistant to punctures. tears, and abrasions?

Flexibility - Does clothing allow for physical movement during normal use? (Especially important in gloves to provide dexterity.)

Thermal limits - Does clothing maintain it's mobility and protective capacity in temperature extremes?

Cleanability - Can material be easily cleaned and reused?

Longevity - Will clothing resist aging?

III. Chemical Resistance

Degradation -The loss of, or change in, the fabric's chemical resistance or physical properties due to reaction with the contaminant

Penetration - The movement of chemicals through stitched seams, zippers, or imperfections in a protective clothing material.

Permeation - The process by which a chemical dissolves in and/or moves through a protective clothing material on a molecular level. The degree of permeation is a function of contaminant concentration, contact time, and material thickness.

NOTE. Always refer to chemical resistant/compatibility charts for specific applications.

IV. Protective Materials

A. *Butyl Rubber* - Resists degradation by many contaminants except halo generated hydrocarbons and petroleum compounds. Especially resistant to vapors and gases.

B. *Chloropel* - Also referred to as CPE or chlorinated polyethylene. Used in splash suits and fully encapsulating suits.

C. *Natural Rubber* - Resists degradation by alcohols and caustics. Used in boots and gloves.

D. Neoprene - Resists degradation by caustics, acids, alcohols, and oils. Used in respirator facepieces.

E. *Nitrile* - Resists degradation by petroleum compounds. alcohols, acids, and caustics. Also reasonably good for chlorinated compounds.

F. *Nomex* - Aromatic polyanude fiber. Non combustible and flame resistant up to 220ºC. Very durable and acid resistant Used in fire flghter's turnout gear.

G. *Polyvinyl Chloride* - Resists degradation by acids and caustics. Used primarily in boots and gloves.

H. *Saranex* - Made of Saran. a Dow product coated on tyvek. Very good general purpose disposable material.

I. *TyvekIPoly coated Tyvek*- Spun-bonded non-woven polyethylene fibers. Has reasonable tear, puncture, and abrasion resistance. Inexpensive and suitable for disposable garments.

J. *Viton* - Fluoroelastomer material similar to Teflon. Excellent resistance to degradation and permeation by aromatic and chlorinated hydrocarbons and petroleum compounds. Very resistant to oxidizers. Susceptible to degradation by acetone.\

V. Protective Equipment

A. *Head Protection* - Many confined spaces present overhead hazards, the use of hardhats can eliminate the possibility of injury to the entrant. The use of chin or nap straps will assist in keeping this protection securely in place.

B. *Foot Protection* - Although many workplaces require the wearing of steel or Polymer Toed safety shoes or boots, to prevent foot injuries from impacts. chemical resistant boots or boot covers many also be necessary to prevent exposure to entrants. Proper sizing of these additional protective boots is important as to not increase the potential for trip hazards.

C. *Eye and Face Protection* - The protection of the eyes and face is essential in confined space work. Selection of the proper type of protective equipment must be based on known or potential hazards (i e Safety glasses with side shields present very little protection from the possibility of splash hazards.)

The following is a list of common eve and face protective devices It is sometimes necessary to utilized more than one of these devices in conjunction with another to assure safe operations within a confined space:

- safety glasses with side shields
- Splash goggles
- Full face shield
- Hoods (abrasive blasting/chemical resistant)

D. *Hearing Protection* - The hazards associated with noise are usually increased when working within a confined space due to the configuration of the work place. During high noise operations hearing protection must be worn. Audible warning alarms should be designed so that even with the required hearing protection entrants can detect alarm activation.

V. Fall Protection and Extraction Equipment

While entering, working in or exiting a confined space the use of fall protection and or extraction equipment is necessary to ensure entrants safety.

The standard states:

Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level or above the entrants head....

A mechanical extraction device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet deep....

A. *Safety belts and Harnesses* - Safety belts and harnesses are manufactured in various styles, sizes and materials (leather/nylon webbing). Most have the capability of being adjusted by a series of straps and buckles to ensure proper fit to the wearer. The type and style of belt or harness must be based on the specific hazards associated with a particular space

B. *Wristlets* - Wristlets consist of strapping or loops (leather/nylon) which are worn around the wrists of the entrant, and are attached to a retrieval line. When utilized wristlets they should be worn in conjunction with a harness assembly. Wrisriets are worn by entrants for safe entry and rescue purposes They are designed to assist in the passage through smaII opening, and will raise the wearers arms over their heads thus reducing the width of the shoulders. Wristlets used without a harness can exert a great deal of strain to the shoulder and neck area increasing the possibility of injury to the wearer.

C. *Retrieval Lines* - The use of retrieval lines, when applicable, is required by the standard. Although requirements for strength are not mentioned in the text of Confined Space Entry, OSHA does address Lifeline requirements in 1926-104:

a minimum of 314 inch manila or equivalent, with a minimum breaking strength of 5400 lbs.

* Retrieval lines must be affixed to an anchor point outside the permit required confined space.

D. *Mechanical Lifting Devices (Extraction Devices)* - There are many types of Mechanical lifting devices available on the market today. They are designed for the purpose of extricating (removing) individuals from a confined space during rescue operations. They can be powered by various means. manual, pneumaic or electrical. The known or potential hazard should dictate the type of device used. Limitations (devices maximum operating length) and capacities (weight) must also be a consideration in their use. The use of a Tripod in conjunction with the lifting device is necessary with many vertical entries. There are some commercially manufactured devices for horizontal extraction also

VII. Communications

Communication between entrants and attendants can be accomplished through the use of radios, verbally if space size and configuration allow or by the use of pre-determined line signals.

Retrieval Line signals

Okay = 1 Tug on line
Advance the line = 2 Tugs on line
Take up slack in line = 3 Tugs on line
Help = 4 or more tugs on line

GLOSSARY

Confined Space Terminology

Acceptable Entry Conditions - means 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 into and work within the space.

Attendant - An individual positioned outside the space who is trained according to the standard. Primary functions include monitoring authorized entrants inside the space and the initiation of any emergency actions as required.

Authorized Entrant - An individual who is trained according to the standard, who's primary function is to entry a permit required confined space to perform the tasks specified by the entry permit.

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

Double Block and Bleed - means the closure of a line, duct or pipe by closing and locking or tagging two in-line valves by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

Emergency - means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

Engulfment - means 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.

Entry - The intentional act of passing through an opening or portal by an entrant into a permit space. An entry is considered to have taken place when any part of the entrant's body breaks the plane at the entry point.

Entry Permit - A written or printed document that is provided by the employer, the content of which is based on the employers hazard identification and evaluation for that confined space (or class or family of confined spaces. if a number of spaces may contain similar hazards) and is the instrument by which the employer authorizes his/her employees to enter a permit required confined space.

Enrty Supervisor - Individual who is responsible for authorizing entry into a permit required confined space. Who's duties include but are not limited to the completion and posting of the entry permit.

Hazardous Atmosphere - A atmosphere which may expose the entrant to a risk of incapacitation, injury, acute illness or the risk of death from one or more potential hazards.

- oxygen deficient (Less than 19.5%) or oxygen enriched (greater than 23.5%).
- flammable atmospheres in excess of 10% of it's lower flammable or explosive limit (LFL - LEL).
- combustible dusts that in it's airborne concentration obscures vision at 5 feet or less.
- Concentrations of chemicals above established OHA permissible exposure limits (PEL) that entrants may be exposed to.

any condition recognized as immediatly dangerous to life or health or has the potential to become IDLH.

Hot Work - any work that may or has the potential to produce sparks. static electricity or any other source of potential ignition, such as drilling, cutting/ burning, welding, grinding, abrasive blasting or

heating.

IDLH - Immediately Dangerous 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 individuals ability to escape unaided from a permit space.

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 non-combustible.

Isolution - a means by which a confined space is rendered safe from the possibility of a release of materials or energy into the space by means of one or more of the following procedures: lockout/ tagout. blinding or blanking of lines, double block and bleed., physical disconnect of piping or mechanical devices.

Lockout - a method for keeping equipment from being set in motion or engaging that could possibily endanger entrants in a confined space.

LEL or LFT - the minimum concentration of a flammable gas or vapor that will ignite given a source of ignition. The lower flammable linits or lower explosive linits are expressed in percentage of volume in air.

Oxygen Deficient / Oxygen Enriched - See Hazardous atmosphere.

PEL (permissable Exposure Limit) - maximum concentration of chemical exposure which an employee may be exposed to in an eight hour day. As listed in OSHA's list in 29 CFR 1910.1000 Subpart Z.

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

Rescue Service - means the personnel designed to rescue employees from permit spaces.

Retrieval System - means a device or equipment (including retrieval lines, chest harness or full body harness wristlets, if appropiate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

Testing (monitoring) - means the process by which the hazards that may confront enttrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space. Testing is essential to determine if acceptable entry conditions exist prior to and during a permit space entry.