CONFINED SPACE AWARENESS

INSTRUCTOR GUIDE

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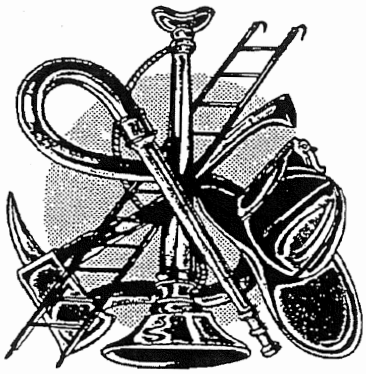

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Kent Freeman, Captain
Roseville Fire Department

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INTRODUCTION

This publication is intended to serve as an Instructor's Guide. The Guide has been designed to include lesson plans, activity sheets, study sheets, information sheets, overhead transparency masters, and quizzes when possible. Suggested application methods have been identified throughout each lesson for the instructor's use at appropriate times during their presentation.

The success of the students in this course depends greatly on the instructor's conformance to the student behavioral objective prescribed at the start of each lesson. The remaining portion of the lesson plan has been designed to serve only as a guide; and as such, should not preclude instructors from adapting their lesson plans to best meet the needs of the students.

Each page within the Instructor Guide is identified in the upper left corner with either of two headings (Instructor Guide or Student Info) that identifies the purpose of the information contained on the page.

INSTRUCTOR GUIDE

Material on these pages is intended to serve as an outline of instruction in lesson plan form. For each topic identified in the course outline, a lesson plan has been developed that contains: a time frame, level of instruction, behavioral objective, materials needed, references, preparation statement, and lesson content.

- TIME FRAME. The minimum, estimated duration required for "in class" presentation based on a 7 hour, one day course.

- LEVEL OF INSTRUCTION. Identifies the instructional level which the material was designed to fulfill. Obviously, instructors have the latitude to increase the level based on time available, local conditions and the students' apperceptive base.

- BEHAVIORAL OBJECTIVE. The behavioral objective is a statement of the student's performance desired at the end of instruction. Instructors must make sure that enough information is given in the presentation to enable the student to perform according to the goal.

- MATERIALS NEEDED. This should be a complete list of everything instructors will need to present the lesson, including Information Sheets, (handout materials), visual aids, quizzes, and so on.

- REFERENCES. These are the specific references the curriculum development team utilized when developing the lesson plan. In addition, references may be listed as additional study aids for instructors to enhance the lesson -- books, manuals, bulletins, scripts, visual aid utilization plans and the like.

- PREPARATION. The motivational statements in this section connect the student with the lesson plan topic through examples or illustrations relating to their occupation, injury, and even mortality. Instructors may modify this section to better fit their students' environment.

- LESSON CONTENT. Includes information utilized in the four-step method of instruction.

Presentation Includes	**Application** Includes
Everything the Instructor says or displays	Everything the student participates in
Content	Questions to the students
Notes	
Overhead and/or Slide cues	
Distribution of Information Sheets	

STUDENT INFO

They contain information related to specific topics within the curriculum in the form of information sheets, activity sheets, study sheets, charts, forms, etc. These pages must be copied and distributed to the students as indicated in the lesson.

CONSIDERATIONS FOR LESSON DELIVERY

The information within the course is designed for presentation without the use of commercially or locally developed films, video tapes and slides. This does not mean that instructors are prohibited from employing audio/visual aids during the course. Instructors are encouraged to utilize any audio/visual which will assist in the presentation of material and attainment of performance goals.

The students should be required to review the material previously covered and scan the material in upcoming class sessions. This will facilitate topic development and provide instructors with a more receptive student base for class discussions.

CONFINED SPACE AWARENESS LEVEL

COURSE OBJECTIVES: To...

a) Introduce fire service personnel to the codes that impact operations within confined spaces.

b) Provide fire service personnel with the information to identify confined spaces and permit confined spaces.

c) Introduce fire service personnel to the hazards of confined spaces.

d) Introduce fire service personnel to the equipment and procedures required to deal with a confined space rescue safely and legally.

e) Introduce fire service personnel to the basic operational positions, and their responsibilities as set forth by CAL-OSHA.

f) Prepare fire service personnel for confined space entry/rescue training.

COURSE CONTENT . . . . . 7:00 HOURS

Lesson Plans

1-1	Introduction to CAL-OSHA Code, Confined Space Identification & Dangers	1:30
2-1	Atmospheric Hazards and Air Monitors	1:00
3-1	Physical and Engulfment Hazards	0:30
4-1	Lock-Out/Tag-Out Procedures and Entry Permits	0:30
5-1	Ventilation Equipment and Techniques	0:30
6-1	Respiratory Equipment and Techniques	0:30
7-1	Communications Equipment and Techniques	0:30
8-1	Entrant Retrieval Equipment	0:30
9-1	Confined Space Operational Positions and Responsibilities	0:30
	Review and Written Quiz	1:00

TEXTS & REFERENCES:

- Title 8, California Code of Regulations, (CCR), General Industry Safety Orders, (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, NIOSH, January 1994

TOPIC: **Introduction to CAL-OSHA Code, Confined Space Identification and Dangers**

TIME FRAME: 1:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- recognize regulations governing operations in confined spaces
- identify the definitions of permit and non-permit confined spaces
- identify differences between confined spaces and permit confined spaces
- identify operations that make confined spaces dangerous

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Pages 1 through 3 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Overhead projector and screen
- Overhead transparencies for this lesson plan
- Slide projector
- Slides 1-1 through 1-21
- Written quiz
- Information Sheet 1-1, 1-2

REFERENCES:

- Information Sheet 1-1, Pages 1 through 3
- Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: The fire services responsibilities are ever widening. Until recently we may have not considered confined space rescue our responsibility, or if we did we may have encountered it just as we would handle any other technical rescue. Research has shown that we cannot deal with confined space incidents like routine technical

rescues, and regulations won't permit us to. Recent changes to State and Federal regulations has caused many employers to re-evaluate their Confined Space program. In an attempt to comply with these regulations, many employers are relying on outside rescue services such as fire departments. Requests for our services will undoubtably increase, thus we must be well versed in confined space operations. Only through understanding what constitutes a confined space, the dangers they pose, and the regulations that apply to our operations in them, can we complete a safe and successful rescue in these hazardous environments.

PRESENTATION	APPLICATION
NOTE: Distribute Information Sheet 1-1, Confined Space Entry Awareness Training and Information Sheet 1-2, Confined Space Regulations (Title 8). These handouts are referred to throughout the course. This course is based on the February 1994 edition of Title 8 CCR GISO, Sections 5156, 5157, 5158. Revisions and updates to that document will require the instructor to update affected sections of this course.	
I. REGULATIONS AFFECTING CONFINED SPACE OPERATIONS	
OHT 1-1	
A. February 1994 CAL-OSHA enacted their final rule for confined space regulations.	
1. Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), Sections 5156, 5157, 5158	
B. Outside California FED-OSHA has a near identical document	
C. American National Standards Institute (A.N.S.I.) and National Institute for Occupational Safety and Health (N.I.O.S.H.) guidelines are also used	
	Why did OSHA update the confined space regulations?
II. FATALITY STATISTICS	
OHT 1-2	
A. Studies reveal that every year approximately 67 preventable deaths occur in confined spaces	

PRESENTATION	APPLICATION
B. As many as 60% of the deaths occur to would be rescuers	
OHT 1-3	
C. Research reveals interesting facts regarding the causes of deaths in confined spaces	
1. 65% hazardous atmospheres	
2. 13% engulfment	
3. 7% struck by falling objects	
4. 6% heat stress/exposure	
5. 4% others	
	What are other possible reasons or advantages from the new changes to the Confined Space regulations?
NOTE: Recent changes in the confined space regulations also provide the mechanism for satisfying required Injury & Illness Prevention Program (IIPP) elements with respect to confined space safety.	
III. INJURY AND ILLNESS PREVENTION PROGRAM	
A. Safety responsibility	
B. Compliance/recognition	
C. Employee-employer communication	
D. Workplace inspections/evaluations	
E. Correction of hazards	

PRESENTATION	APPLICATION
F. Injury/illness investigation	
G. Training	
H. Recordkeeping	
IV. DEFINITIONS OF CONFINED SPACES	
A. Confined spaces are sub-grouped in two groups	
1. Confined spaces	
OHT 1-4	
a) Is large enough and so configured that an employee can bodily enter and perform assigned work; and	
b) Has limited or restricted means for entry or exit; and	
c) Is not designed for continuous employee occupancy	
2. Permit required confined spaces	

PRESENTATION	APPLICATION
OHT 1-5	
NOTE: The space must meet the definition of a confined space plus one of the following. a) Contains or has the potential to contain a hazardous atmosphere b) Contains a material that has the potential for engulfing an entrant c) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor which slopes and tapers to a smaller cross section; or d) Contains any other recognized serious safety or health hazard	
V. SLIDE PRESENTATION OF CONFINED SPACES	
SLIDE 1-1	
	Is this a confined space? Is it a permit required confined space?
NOTE: Yes, this is a permit required confined space.	
	Does this appear to be a legal entry?
NOTE: No, it is not legal and you'll see as we continue what the requirements of a permit required space are.	
SLIDE 1-2 & 1-3	

PRESENTATION	APPLICATION
SLIDE 1-4, 1-5, 1-6, 1-7	
NOTE: This is a common operation, with numerous people working in vaults like this one in every area of California.	
Vaults vary in size and depth with the average being 9' to 10' deep, and 6' wide by 12' long.	
SLIDE 1-8	
NOTE: Obviously these are common and can quite easily meet the criteria for a permit confined space if the given factors are present. (non-vented)	
SLIDE 1-9	
NOTE: These containers are quite common and can quite easily fall into the realm of permit required confined spaces also.	
SLIDE 1-10	
	Is this a confined space by definition? If so, is it a permit required confined space?
NOTE: Compare it to the criteria listed. You may think it is pushing it to call it a permit required confined space, but when looking honestly at the definition it is obvious that it can easily meet the criteria. When evaluating a space the safest approach is to consider the space permit required first until determined otherwise.	

PRESENTATION	APPLICATION

SLIDE 1-11

NOTE: This would take even less of a stretch to qualify as a permit required confined space as the outhouse does not have fans or H.V.A.C. like an indoor unit has.

Obviously both of these examples are extreme, but they illustrate how far the interpretations of these definitions can be stretched.

SLIDE 1-12

NOTE: This facility meets the criteria for a permit required confined space. It has the hazard of possible entrant engulfment, as well as inwardly converging walls, and a floor that tapers to a smaller cross-section.

SLIDE 1-13

NOTE: This is a permit required space, these cars have manways with openings from 17" to 30" in diameter. Occasionally these cars are cleaned inside by personnel, and maybe occupied by unauthorized riders.

SLIDE 1-14

NOTE: This would not normally be considered a potential hazard as a pressure car does not have any openings large enough for humans to enter unless the top is unbolted during service. If the space is accessible it must be considered a permit required space.

SLIDE 1-15

NOTE: These cars not only have the potential for engulfing an entrant, but they also have floors that taper to a smaller cross-section.

PRESENTATION	APPLICATION
SLIDE 1-16 NOTE: This is considered a permit required space. SLIDE 1-17 NOTE: Don't be deceived by the open ends in this culvert, the same dangers exist whether it's 100' or 10'. SLIDE 1-18 NOTE: If certain factors are present this can meet the criteria for a permit required confined space. SLIDE 1-19 NOTE: This meets the criteria for a permit required space, when considering the intended product we are reminded of the potential for a hazardous atmosphere, engulfment, or physical hazards with the large aerators that stir the product. SLIDE 1-20 NOTE: Obvious permit required space, be advised this and slide 19 are commonly cleaned from inside by personnel with hand tools. SLIDE 1-21 NOTE: This meets the criteria for a permit required space.	

PRESENTATION	APPLICATION
VI. TYPICAL PERMIT REQUIRED CONFINED SPACES	
A. Storage tanks	
B. Pump wet wells	
C. Degreasers	
D. Digesters	
E. Sewers	
F. Person holes	
G. Tunnels	
H. Underground vaults	
I. Boilers	
J. Silos	
K. Vessels	
L. Grain elevators	
M. Mixers	
N. Open topped water tanks	
O. Water towers	
P. Enclosures with bottom access	
Q. Rail car tanks	
VII. DANGERS OF CONFINED SPACES	
	What makes confined spaces so dangerous?

PRESENTATION	APPLICATION
A. Oxygen deficiency	
B. By-products of previously stored material	
1. Storage tanks retain residue	
2. Product is absorbed into tank walls	
C. Accidental leaks or spills	
1. Leaks of substances give off vapors or cause reactions	
2. Slip, trip or fall hazard	
D. Chemical reactions	
1. Accidental mixing of chemicals	
2. Drying paint	
3. Multiple use tanks	
E. Oxidation	
1. Rusting of metals	
2. Rotting or decomposing organic materials	
F. Mechanical operations	
1. Welding	
2. Painting	
3. Cleaning	
4. Scraping or sandblasting	
5. Mixing/stirring operations	

PRESENTATION	APPLICATION
6. Recharging of batteries	
G. Inerting activities	
1. Carbon dioxide (CO_2)	
2. Helium (HE)	
3. Nitrogen (N_2)	
	What other hazards can be found in confined spaces?
VIII. TYPES OF CONFINED SPACE HAZARDS	
A. Confined space hazards are basically grouped into six groups	
1. Atmospheric hazards	
2. Physical hazards	
3. Engulfment hazards	
4. Corrosive hazards	
5. Biological hazards	
6. Other hazards	

SUMMARY:

Confined spaces are quite common throughout any jurisdiction. Whether these spaces are pipelines, underground vaults, tanks, grain silos or any other configuration is not important. The critical fact is that we as rescuers can identify them as confined spaces and that we understand what makes them so dangerous. Only through training can we be confident that we will respond to these incidents with the information to be successful without placing ourselves in jeopardy.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

Confined Space Entry
Awareness Training

Confined spaces represent a major health and safety risk for fire fighters. Being able to recognize and plan appropriately for confined space work can mean the difference between a job well done and disaster.

This booklet is structured to help identify what constitutes a confined space, what hazards can be found in confined spaces, how those hazards can impact the authorized entrant and what should be done to protect entrants functioning in confined spaces.

It also discusses equipment that can be used in confined space applications, ranging from environmental surveillance and monitoring equipment to respiratory protection equipment, protective clothing and lowering/retrieval systems.

What is a Confined Space?

A confined space is defined as an area that:

- Is large enough for an employee to bodily enter and perform work; and
- Has limited or restricted means of entry or exit; and
- Is not designed for continuous human occupancy;

A **permit-required** confined space is defined as a **confined space** that has one or more of the following:

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

Confined spaces come in many sizes and shapes, and can be found in heavy industry, food, chemical and petroleum processing, utility and communications installations and construction sites, to name only a few. These spaces often are deceiving in appearance. For example, the interior of an open-topped water tower is defined as a confined space, even though the top is open to the outdoor environment. As a rule of thumb, the following areas are typically classified as confined spaces, and should be treated with caution:

Storage tanks
Pump wet wells
Degreasers
Sewers
Person holes
Tunnels

Underground vaults
Boilers
Silos
Vessels
Grain elevators
Mixers

Open-topped water tanks
Water towers
Enclosures with bottom access
Railcar tanks

In most cases, these confined spaces are fairly easy to spot. If, however, you encounter an area that has any of the characteristics of a confined space, but is not included in the listing above, it is always best to treat the unknown area and its interior environment like a permit required confined space and to take all necessary safety precautions.

WHAT MAKES A CONFINED SPACE DANGEROUS?

Oxygen Deficiency

An atmosphere with less than 19.5% oxygen by volume, is considered oxygen deficient. When the percentage of oxygen falls to levels below 19.5%, physiological effects are routinely noted. If oxygen levels continue to drop total incapacitation will occur, followed by death. Oxygen deficiency can occur for numerous reasons, many of which are listed in this section.

By-Products of Previously Stored Materials or Chemicals

Confined spaces used for the storage of petroleum products, chemicals and other substances can often absorb or retain material. When the space is emptied for maintenance, cleaning or other purposes, this absorbed material can leach back out of the walls, changing the composition of the confined space environment.

Accidental Leaks or Spills

Accidental leaks or spills of such substances as ammonia, acetylene, acids or even plain water can create a variety of hazards within a confined space. These substances can give off fumes and vapors, or can cause reactions that can create sudden and major changes in the confined space environment. These hazards may also contribute to an increased likelihood of "slip, trip and fall" accidents.

Chemical Reactions

Chemical reactions within a confined space may be caused by a variety of circumstances. Manufacturing processes can generate by-products that react with the atmosphere in the confined space to produce a hazardous condition. Cleaning with acids or solvents can give off vapors and fumes that may become a serious health hazard. Similarly, drying paint can create toxic vapors that could pose a serious health threat or react violently with the confined space atmosphere.

Oxidation

Oxidation processes, such as rusting of metals or the rotting, decomposition and fermentation of organic materials can deplete the oxygen level in a confined space area. Special care should be taken in such atmospheres, because human respiration, combined with oxidation, can quickly reduce the oxygen levels in a confined space below acceptable levels.

Mechanical Operations

Operations within a confined space, such as welding, painting, cleaning, scraping or sandblasting can generate confined space hazards. Sudden changes in temperature, combined with the release of petrochemical fumes or methane gas, can create unstable environments that may produce such volatile reactions. Special care should be taken in spaces such as telephone vaults, basements and tunnels that contain rechargeable batteries. Recharging operations can produce significant levels of explosive gases or toxic gases, which can displace oxygen within the confined space area.

Inerting Activities

Finally, inerting with non-flammable products such as carbon dioxide (CO_2), helium (He), and nitrogen (N_2), may displace oxygen within a confined space. These products may also combine with other materials in the space to create hazardous substances.

WHAT HAZARDS ARE FOUND IN A CONFINED SPACE?

A variety of hazards can be found in a confined space work environment. As a result, careful planning and preparation of all personnel involved in the confined space entry should occur before anyone enters the work area. Hazards can be grouped into one of six groups. They are: atmospheric hazards; physical hazards; engulfment hazards; corrosive hazards; biological hazards; and other hazards.

Atmospheric Hazards:

Atmospheric hazards are some of the most dangerous, yet frequently unnoticeable hazards found in a confined space. A hazardous atmosphere is an atmosphere which exposes employees to a risk of death, incapacitation, injury or acute illness from one or more of the following causes:

- An atmospheric oxygen concentration below 19.5% (oxygen deficiency), or above 23.5% (oxygen enrichment).
- A flammable gas or vapor in excess of 10% of its lower explosive limit (LEL).
- An atmospheric concentration of any toxic contaminant (found in section 5155 for airborne contaminants) above the OSHA permissible exposure limit (PEL).
- An airborne combustible dust at a concentration that obscures vision at a distance of five feet or less.
- Any immediately dangerous to life or health (IDLH) atmosphere which poses an immediate threat of loss of life; may result in irreversible or immediate, severe health effects; may result in eye damage, irritation or other conditions which could impair escape.

While airborne dust or particle concentrations may be easy to spot with the naked eye, oxygen deficiency or enrichment conditions, as well as hazardous concentrations of vapors or gases must be detected with reliable instrumentation.

Oxygen Deficiency

Normal ambient air contains an oxygen concentration of 20.8% by volume. When the oxygen level in the confined space dips below 19.5% of the total atmosphere, the area is considered oxygen deficient. In oxygen deficient atmospheres, life-supporting oxygen may be displaced by other gases, such as carbon dioxide, which results in an atmosphere which can be dangerous or fatal when inhaled. Oxygen deficiency may also be caused by rust, corrosion, fermentation or other forms of oxidation which consume oxygen. As materials decompose, oxygen is drawn from the atmosphere to fuel the oxidation process.

The impact of oxygen deficiency can be gradual or sudden, depending on the overall oxygen concentration levels of other gases in the atmosphere. Typically decreasing levels of atmospheric oxygen cause the following physiological symptoms:

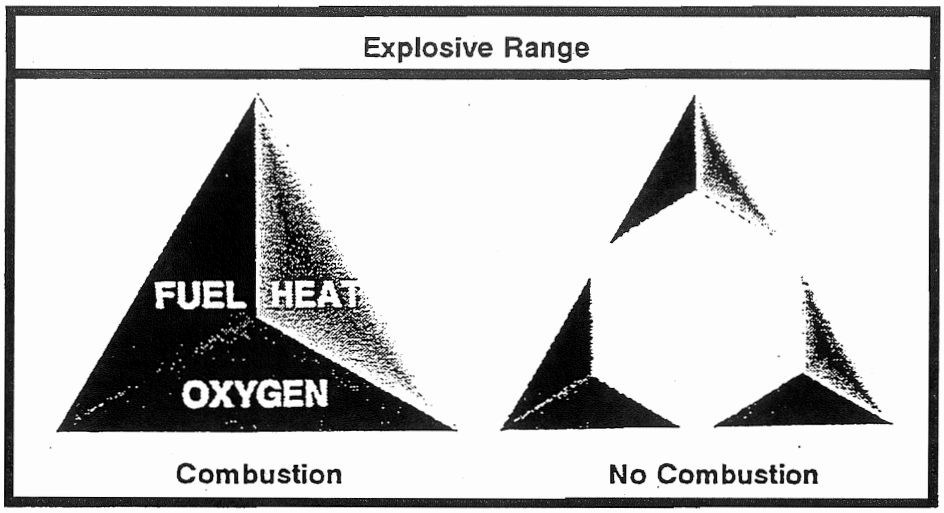
% Oxygen	Physiological Effect
19.5 - 16	No visible effect
16 - 12	Increased breathing rate. Accelerated heartbeat. Impaired attention, thinking and coordination.
14 - 10	Faulty judgment and poor muscular coordination. Muscular exertion causing rapid fatigue. Intermittent respiration.
10 - 6	Nausea, vomiting. Inability to perform vigorous movement, or loss of the ability to move. Unconsciousness, followed by death.
Below 6	Difficulty breathing. Convulsive movements. Death in minutes.

Oxygen Enrichment

When the oxygen concentration rises above 23.5% by volume, the atmosphere is considered oxygen enriched, and is prone to become unstable. As a result of the higher oxygen level, the likelihood and severity of a flash fire or explosion is significantly increased.

COMBUSTIBLE GASES

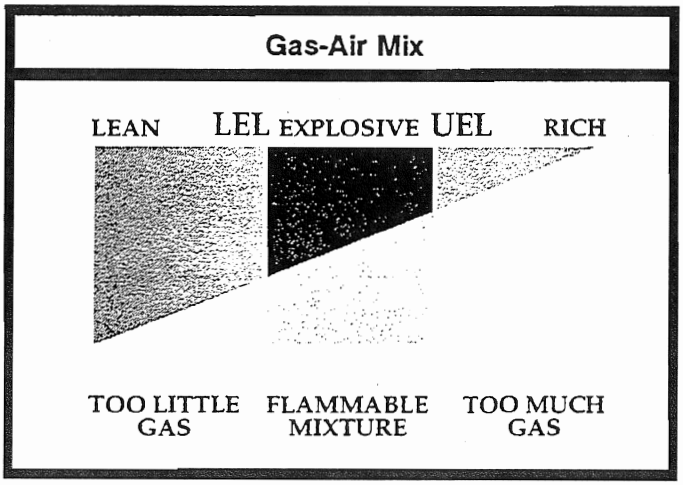
FIGURE 1



In order for combustion to occur, there must be three elements: 1. fuel, 2. oxygen to support combustion and 3. heat or a source of ignition. This is known as the fire triangle (see Figure 1), but if you remove any one of the legs, combustion will not occur.

The percentage of combustible gas in the air is important, too. For example, a person hole filled with fresh air is gradually filled by a leak of combustible gas such as methane or natural gas, mixing with the fresh air. As the ratio of gas to air changes, the sample passes through three ranges: lean, explosive and rich (see Figure 2).

FIGURE 2



In the lean range there isn't enough gas in the air to burn. On the other hand, the rich range has too much gas and not enough air. However, the explosive range has just the right combination of gas and air to form an explosive mixture. Care must be taken, however, when a mixture is too rich, because dilution with fresh air could bring the mixture into the flammable or explosive range. An analogy is the automobile that won't start on a cold morning (a lean atmosphere because the fluid gasoline has not vaporized sufficiently), but can be flooded with too much gasoline (a rich atmosphere with too much vaporization). Eventually when the right mixture of gas and air finally exists (explosive), the car starts.

When considering combustible gases methane and carbon monoxide are two of the more common found in confined spaces. Both methane and carbon monoxide are colorless and odorless, and methane is considered non-toxic. Carbon monoxide is close to the same vapor density as air while methane is lighter than air and will accumulate in the upper areas of a confined space. These facts coupled with familiarity of the names methane and carbon monoxide may give us the impression that they are really not a big concern or threat, ***don't be fooled !!!*** Carbon monoxides' wide explosive range (12.5% to 74.2%), and methanes respectable explosive range (5% to 15%), combined with the ability these gases have to displace oxygen and asphyxiate an entrant without warning, makes them as legitimate a concern as any toxic gas or hydrocarbon.

TOXIC GASES

The physiological effects of the following toxic gases common to confined spaces are approximations and will vary according to the health or activity of the individual exposed.

Carbon Monoxide (CO)

A colorless, odorless gas generated by the combustion of common fuels with an insufficient supply of air or where combustion is incomplete. It is often released by accident or improper maintenance or adjustment of burners or flues in confined spaces and by internal combustion engines.

Called the "silent killer," CO poisoning may occur suddenly. The permissible exposure limit (p.e.l.) for carbon monoxide is 25 PPM for an eight (8) hour TWA. This very low p.e.l. alone affirms that physiological effects may be noted sooner than those shown.

PPM Level (CO)	Physiological Effect
100 ppm for 3 hours or 600 ppm for 1 hour	Headache and discomfort
500 ppm for 1 hour or 1000 ppm for 30 minutes	Pounding of heart, dull headache, dizziness, flashes before eyes, ringing in ears, nausea.
1500 ppm for one hour	Dangerous to life.
4000 ppm	Rapid collapse, unconsciousness and death within a few minutes.

Hydrogen Sulfide (H_2S)

This colorless gas smells like rotten eggs, but the odor cannot be taken as a warning because sensitivity to smell disappears quickly after breathing only a small quantity of the gas. It is often found in sewers or sewage treatment facilities and in petrochemical operations. In addition, H_2S is flammable and explosive in high concentrations.

Sudden poisoning may cause unconsciousness and respiratory arrest. In less sudden poisoning, symptoms are nausea, stomach distress, eye irritation, belching, coughing, headache and blistering of lips. The p.e.l. for hydrogen sulfide is 10 PPM, thus physiological effects may be experienced at lower concentrations than those shown

*** Hydrogen Sulfide (H_2S)**

PPM (H_2S)*	Physiological Effect
15 - 25 ppm	Eye irritation
50 - 150 ppm for several hours	Slight eye, respiratory irritation.
170 - 300 ppm for 1 hour	Marked irritation.
400 to 600 ppm for 1/2 - 1 hour	Unconsciousness, death.
1000 ppm	Fatal in minutes.

Sulfur Dioxide (SO_2)

The combustion of sulfur or compounds containing sulfur produces this pungent, irritating gas. Severe exposures may result from loading and unloading tank cars, cylinders or lines either rupturing or leaking, and fumigation aboard ships.

PPM Level (SO_2)	Physiological Effect
1 - 10 ppm	Respiratory and pulse rates increase, depth of respiration decreases.

Ammonia (NH_3)

A strong irritant that can produce sudden death from bronchial spasms. Small concentrations that do not produce severe irritation are rapidly passed through the respiratory tract and metabolized so that they no longer act as ammonia. If you've ever taken a "whiff" of a household cleaning solution and had it "take your breath away," you have a good idea of the problems that a more severe industrial exposure can present.

Ammonia can be explosive if the contents of a tank or refrigeration system are released into an open flame.

*** Ammonia (NH_3)**

PPM Level (NH_3)*	Physiological Effect
300-500 ppm for 30 - 60 minutes	Maximum short exposure tolerance. Eye and respiratory irritation.
400 ppm	Throat irritation.
2500 - 6000 ppm for 30 minutes	Dangerous to life.
5000 - 10,000 ppm	Fatal

Exposure Levels for Selected Toxic Gas

Substance	*Threshold Limit Value (PPM)	*Short Term Exposure Limit (PPM)	OSHA Permissible Exposure Limit (PPM)
Carbon Monoxide	25	---	25
Hydrogen Sulfide	10	15	10
Sulfur Dioxide	2	5	5
Ammonia	25	35	50
Hydrogen Cyanide	10	---	10
Benzene	10**	---	1 (5+)
Toluene	50	---	200
Xylene	200	150	100

* 1992-93 Threshold Limit Values published by American Conference of Governmental Industrial Hygienists.
** Suspected human carcinogen
\+ Short term exposure limit.

Hydrogen Cyanide or Hydrocyanic Acid (HCN)

An extremely rapid poison which interferes with the respiratory system of the body's cells and causes chemical asphyxia. Liquid HCN is an eye and skin irritant.

Aromatic Hydrocarbons (i.e. Benzene, Toluene, Xylene)

Benzene: a colorless, flammable, volatile liquid with a rather pleasant aromatic odor. Chronic poisoning may occur after breathing comparatively small amounts over a period of time. The first sign is exhilaration, followed by sleepiness, dizziness, vomiting, trembling, hallucinations, delirium and unconsciousness.

Toluene: a colorless, flammable liquid whose rather strong aromatic odor warns of high concentrations. It produces extreme fatigue, mental confusion, exhilaration, nausea, headache and dizziness.

Xylene: a solvent mixture that resembles benzene in many chemical and physical properties.

ELECTRONIC INSTRUMENTS AND ALARMS

Battery-powered, direct-reading instruments are considered by many experts to be the most practical devices for conducting spot checks of a confined space atmosphere on a semi-continuous basis. These monitoring devices, which are classified by two groups--single-gas instruments or multiple-gas instruments-typically monitor one or a combination of the following atmospheric conditions:

(1) Oxygen deficiency or enrichment;
(2) The presence of combustible gas; and
(3) The presence of certain toxic gases.

Oxygen deficiency or enrichment is the first hazard monitored for. This is important to remember as oxygen dificiency may affect accuracy of other readings.

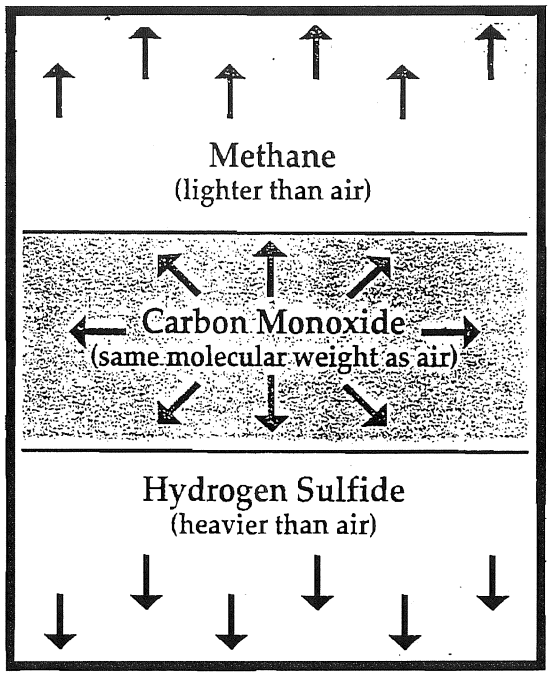
Depending on the capabilities of the instrument, monitoring can be conducted simultaneously for oxygen and combustible gas, or for oxygen, combustible gas and toxic gases. These devices are commonly referred to as 2-in-1, 3-in-1, 4-in-1 or 5-in-1 alarms.

No matter which type of instrument is used to check environmental gas concentrations, regular monitoring should be performed during all confined space operations, since a contaminant's level of combustibility or toxicity might increase even if it initially appears to be low or non-existent. In addition, oxygen deficiency can occur unexpectedly.

ATMOSPHERIC COMPOSITION

To determine the composition of a confined space atmosphere, reliable instruments should be used to draw air samples through a weep hole or other small entry port leading into the confined space. If possible, do not open the entry portal to the confined space before this step has been completed. Sudden changes in atmospheric composition within the confined space could cause violent reactions, or dilute the contaminants in the confined space, giving a false low initial gas concentration.

FIGURE 3



When testing permit spaces for acceptable entry conditions, always test in the following order:

1. Oxygen content
2. Flammable gases and vapors
3. Potential toxic air contaminants

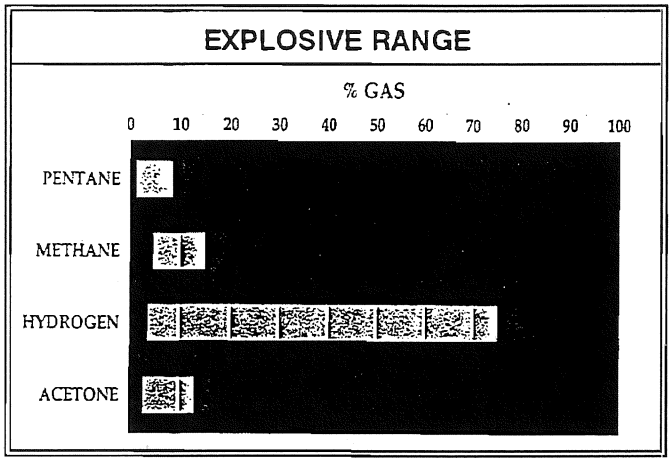
Comprehensive testing should be conducted in various locations within the work area. Some gases are heavier than air, and tend to collect at the bottom of a confined space. Others are lighter, and are usually in higher concentrations near the top of the confined space. Still others are the same molecular weight as air, so they can be found in varying concentrations throughout the confined space. This is why test samples should be drawn at the top, middle and bottom of the space to pinpoint varying concentration of gases or vapors (see Figure 3). The results of the atmospheric testing will have a direct impact on the selection of protective equipment necessary for the tasks in the confined area. It may also dictate the duration of worker exposure to the environment of the space, or whether an entry will be made at all. Substance-specific detectors should be used whenever actual contaminants have been identified.

It should be assumed that every confined space has an unknown, hazardous atmosphere. Under no circumstances should anyone ever enter or even stick his or her head into a confined space for a "quick look." Such an action constitutes entry into the confined space and can expose the entrant to hazardous, and possibly deadly atmospheres.

How Combustible Gas Monitors Work

To understand how portable combustible gas detection instruments work, it is first important to understand what is meant by the Lower Explosive Limit (LEL) and Upper Explosive Limit (UEL) (see Figure 2). When certain proportions of combustible vapors are mixed with air and a source of ignition is present, an explosion can occur. The lowest percentage at which this can happen is the LEL; the highest percentage is the UEL.

FIGURE 4



Most combustible instruments display gas concentrations in percent of the LEL. Some models have gas readouts in percent by volume and others display both percent of LEL and percent combustible gas by volume. What's the difference? For example, the LEL of methane (sometimes called natural gas) is 5 percent by volume, and the UEL is 15 percent by volume. If we slowly fill a room with methane, when the concentration reaches 2.5 percent by volume, it is 50 percent of the LEL; at 5 percent by volume it is 100 percent of the LEL. Between 5 and 15 percent by volume, a spark could set off an explosion.

Different gases need different percent by volume concentration to reach 100 percent of the LEL (see Figure 4). Pentane, for example, has an LEL of 1.5 percent. Instruments that measure in percent of the LEL are easy to use because, regardless of the gas, you are most concerned with how close the concentration is to the LEL.

Single Gas Monitors for Oxygen Deficiency

Oxygen indicators measure atmospheric concentrations of oxygen. Concentrations are generally measured over a range of 0 to 25 percent oxygen in air, with readings being displayed on either an electronic readout or an analog meter.

Oxygen indicators are calibrated with uncontaminated fresh air containing a minimum of 20.8 percent oxygen. With some models, an alarm is activated when oxygen levels drop below 19.5 percent.

Single Gas Monitors for Combustible Gases

Single-gas instruments for monitoring of hydrocarbon vapors operate by the catalytic action of a heated platinum filament in contact with combustible gases. The filament is heated to operating temperature by an electric current. When the gas sample contacts the heated filament, combustion on its surface raises the temperature in proportion to the quantity of combustibles in the sample. A Wheatstone bridge circuit, incorporating the filament as one arm, measures the change in electrical resistance due to the temperature increases. This change indicates the percentage of combustible gas present in the sample.

Single Gas Monitors for Toxic Gases

Compact, battery-powered devices can be used to measure levels of carbon monoxide (CO) or hydrogen sulfide (H_2S), depending on the model selected. Toxic gas monitors use electrochemical cells. If the gas of interest enters the cell, the reaction produces a current output proportional to the amount of gas in the sample. With these instruments, audible and visible alarms sound if the gas concentration exceeds a present level. These devices are well suited for use in confined spaces containing motors or engines, which can generate large quantities of CO, as well as in sewers, waste treatment plants and "sour crude" processing stations which tend to have hazardous volumes of H_2S.

Multiple Gas Monitors for Oxygen and Combustible Gas

In applications where it is necessary to determine oxygen and combustible gas levels simultaneously, 2-in-1 diffusion-type devices can be used. Sensors measure 0 to 100 percent of the LEL and oxygen from 0 to 25 percent. Remote sampling requires either a pump module or an aspirator bulb adapter.

Multiple Gas Monitors for Oxygen, Combustible and Toxic Gases

Toxic gases and vapors, which can be inhaled or absorbed through the skin, are frequently found in confined spaces. Sometimes, these atmospheric hazards can also displace oxygen and may incapacitate the body's ability to maintain respiration. Some toxic gases and vapors can also cause long-term physical damage to the body in cases of repeated exposure.

A number of instruments are available to assist in detecting toxic gas. Whereas the pocket size monitors operate by diffusion or an aspiratory bulb, larger (but still hand held) 2-in-1 and 3-in-1 instruments have been developed with built-in pumps to draw samples from the immediate area or from outside the confined space work area when used with sampling lines. For 2-in-1 devices, side-by-side analog displays show percentages for both oxygen and the LEL. With 3-in-1, 4-in-1 and 5-in-1 devices, the user selects either a sensor readout on a digital display or automatic sequential scanning of sensors contained in the instrument. Regardless of the mode selected or the reading being displayed, all sensors should be designed to monitor continuously.

Diffusion-type instruments are available for simultaneously measuring the LEL of combustible gases, oxygen levels and toxic levels (in parts per million) of H_2S, CO and other toxic gases. Alarms also alert the user to low and high oxygen levels. Remote sampling pump adapters are available to convert these diffusion type instruments into pump-style instruments.

Photoionization Detectors for Toxic Gas and Vapors

A photoionization detector, featuring microprocessor technology, uses ultraviolet light to ionize molecules of chemical substances in a gaseous or vaporous state. A real-time digital readout allows the user to make an immediate determination of gas and vapor concentrations. Depending upon calibration input, gas and vapors are measured over a 0.1 to 2000 ppm scale. Photoionization detectors are excellent for use in methane-rich environments, such as sewers and digesters, as the detector will not be affected by the presence of the methane gas. Instead, the detector allows the user to sample for toxic gases, such as benzene, that can be hazardous in concentrations well below their LEL. Not all toxic gases can be measured with photoionization detectors. In addition you would need to use a device capable of sensing concentrations of potential explosive/flammable gases when using photoionization detectors.

Detector Tube Sampling Systems

Detector tube-type devices are recommended for conducting quick evaluations of potential hazards that cannot otherwise be measured. With detector tubes, a known volume of air is drawn through the tube using a manually operated sampling pump. If gas or vapor is present in the air, chemically treated granules in the tube are stained a different color. By measuring the length of the color stain within the tube, users can determine concentration levels.

Most tubes available today are made of glass, have break-off tips, and are filled with treated chemical granules. They generally have a shelf life of 24 to 30 months.

One type of pump frequently used with a detector tube is a compact, bellows-type device. Accurate and repeatable sample flows can be assured by a shaft that guides the bellows during compression. Some models feature an end-of-stroke indicator that lets the user know when a full air sample has been drawn. Models with an integral stroke counter eliminate the tedious recording of multiple pump strokes.

Calibration

To ensure the accuracy of gas monitoring and detection equipment, calibration activities should be frequently performed on all instruments used in confined space applications. Depending on the capabilities of the particular instrument, a calibration kit containing a known gas should be used to compare the actual readings of the instrument to the known values of the test gas. If the instrument reading differs from the values of the known standard, the instrument should not be used until it has been adjusted or repaired, if necessary. Most agencies calibrate all gas monitoring / detection instruments at least monthly according to the manufacturers recommendations.

PHYSICAL HAZARDS

After the atmospheric hazards of a confined space have been identified, it is essential to also pinpoint any physical hazards contained in the work area. Physical hazards, such as grinding equipment, agitators, steam or steam fittings, mulching equipment, drive shafts, gears and other moving parts can pose a danger in confined spaces, in that they can burn, maim or crush entrants in the space. Hazards such as pipe fittings and uneven or wet surfaces may also pose slip, trip and fall hazards.

Engulfment Hazards

Engulfment hazards frequently exist in areas were loose materials such as grains, crushed stone, flour or sawdust are stored. Often housed in silos or other containment equipment, these materials harbor air pockets, which can collapse under the weight of an employee (referred to as BRIDGING). Engulfment hazards either block the employee's airways or compress his/her upper body to the point where suffocation takes place. Many studies reveal engulfment to be the number two cause for death in confined spaces, in fact N.I.O.S.H. surveys reflect as many as 227 deaths attributed to engulfment between 1980-1989

Corrosive Hazards

Corrosive chemicals, such as acids, solvents and cleaning solutions can pose yet another confined space hazard. Contact between these substances and the skin, mucous membranes or eyes can cause serious irritation or burns. Fumes given off by these materials can also irritate the respiratory system and can cause gastrointestinal distress.

Biological Hazards

Biological hazards, such as molds, mildews and spores frequently found in dark, damp spaces can irritate the respiratory system. Bacteria and viruses, found in applications such as sewage treatment, can also threaten the body with a variety of diseases. In addition, bird and animal feces can present serious health hazards to humans, and decaying biological materials can cause oxygen deficiency.

Other Hazards

Other hazards, such as poor visibility, inadequate lighting and insecure footing can cause significant safety hazards in a confined space. Confined spaces may also harbor rodents, snakes, spiders or insects, which may be dangerous to confined space entrants. Finally, sudden changes in wind or weather can contribute to unexpected variations in the confined space environment.

PROCEDURES FOR ENTERING A CONFINED SPACE

Before any employee enters a permit-required confined space, a system of procedures and precautions must be followed. It is essential that supervisors, attendants and entrants all know the specifics of the space. It is also critical to have the correct equipment on hand to ensure worker safety. The following procedures must be followed.

Completion of an Entry Permit

Before anyone enters a confined space, an entry permit must be completed by supervisory personnel. Specifically, the permit must clearly identify:

- The location of the confined space
- The purpose of the entry into the area
- The date of entry and the authorized duration of occupancy in the space. A permit may be valid for a period not to exceed that necessary to complete the task or job for which the permit was obtained
- A listing of authorized entrants
- A listing of attendants
- A listing of necessary tools and equipment
- The signature of the individual authorizing the entry
- A listing of hazards and acceptable entry conditions
- Results of initial and periodic tests
- Measures to isolate the space and eliminate or control the hazards before entry
- A listing of rescue and emergency services
- Communications procedures
- Additional permits (hot work) issued

Before any entry into a confined space begins, the individual authorizing the entry must sign the permit. Upon completion of work in the confined space area, the permit is canceled by the entry supervisor, but retained for at least one year for ease of program review. Any problems must be noted on the permit.

For situations requiring "hot work", such as welding, a notation should be added to the confined space entry permit or a separate hot work permit should be attached. The additional information should detail both the scope and duration of the hot work.

To accurately complete the entry permit, and to inform entrants of the hazards contained within the confined space work area, a comprehensive hazard assessment, listing all hazards that could be encountered by entrants during occupation of the confined space, must be conducted before entry. Persons entering confined spaces and those acting as attendants must also know the signs and symptoms of exposure to a hazard. The assessment should then be followed by a document describing the formal method of operation for all occupants of the confined space. This document should explain in detail all cleaning, purging and ventilating practices, as well as safe work practices. It should be reviewed by all people participating in the confined space entry.

A formal safety procedure should also be documented to cover critical safety concerns such as first-aid, showering and decontamination, and obtaining the necessary rescue and medical equipment.

To ensure the understanding of responsibilities and hazards found in a particular confined space, a pre-entry session for everyone involved in confined space work should be scheduled shortly before entry. At this time, each hazard should be discussed with all authorized entrants and attendants, as well as the consequences of exposure to each hazard.

Confined Space Entry Without Permit/Attendant

OSHA has determined that a complete entry permit program may not be needed for entries into spaces handled by selected industries when they are regulated by other sections of the C.C.R. or C.F.R. Some of the exemptions are as follows:

1.	Construction Operations	(regulated by Section 1502)
2.	Agriculture Operations	(defined by Section 3437)
3.	Marine Terminal Operations	(defined in Section 3460)
4.	Shipyard Operations	(regulated by Section 8437)
5.	Telecommunications person holes and vaults	(Section 8616)
6.	Grain handling facilities	(regulated by Section 5178)
7.	Natural gas utility operations	(Title 49 CFR)
8.	Electric utility operations within underground vaults	

VENTILATION

Regardless of whether respiratory protection is used or not, ventilation is a critical component of any confined space entry. Ventilation is carried out by the use of fans or blowers ranging in size from roughly 700 C.F.M. to over 2000 C.F.M. The fans are connected to duct work and directed into the space. The ventilation operation can basically be conducted in one of three ways, forced supply, forced exhaust, and forced supply and exhaust. Ventilation should begin prior to entry and continue throughout. The upper and lower explosive limits and vapor density of any gases in the space must be considered when ventilating. Atmospheric monitoring will eliminate the possibility of converting an atmosphere that was too rich or too lean to ignite into an explosive environment. In addition, confined spaces shall not be ventilated with pure oxygen.

OSHA allows employers to exempt many of their confined spaces from complete permit entry programs. This exemption is allowed if the space contains only atmospheric hazards which can be controlled by ventilation alone. These spaces can be exempted from complete permit required confined space operations if the employer:

1. Demonstrates that the only hazard posed by the permit space is an actual or potentially hazardous atmosphere.

2. Demonstrates that forced air ventilation alone will maintain the permit space safe for entry.

3. Develops monitoring and inspection data to support 1 and 2 above, and makes the supporting data available to employees.

4. Performs the initial entry to obtain data and subsequent entries in compliance with CAL-OSHA, Title 8 CCR GISO, Section 5157, paragraph (c) (5) (ii), which includes requirements for periodic testing to assure that ventilation is preventing the accumulation of a hazardous atmosphere.

LOCKOUT AND TAGOUT PROCEDURES

In preparation for entry into the confined space work area, utilities and mechanical equipment serving the space should be isolated and disconnected. Lockout procedures must be performed only by an authorized employee. Pipes and steam lines should be blind flanged in the "off" position and locked out with a padlock. Main breakers to electrical service in the space should be thrown to the "off" position and locked out at the breaker panel. To ensure that the power supply to the equipment has been interrupted, all on-off switches should be tested. Hydraulic lines servicing the space should also be blocked and bled to prevent unanticipated movement of the equipment. Finally, if possible, drive mechanisms, gears and belts to all mechanical equipment should be physically disconnected before entry into the confined space area.

Printed tags are used to warn employees that the energy-isolating devices must stay in position and that the tags must not be removed.

EQUIPPING PERSONNEL FOR CONFINED SPACE ENTRY

A wide range of protective equipment is available for protecting entrants to confined space work areas. it is essential that each entrant has the correct equipment for the environment and is versed in its safe and effective use. **Under no circumstances should an employee enter a confined space without the correct training and equipment.**

Tools and Equipment

All tools and equipment required to complete the tasks in a confined space must be collected before entry into the space. The lack of proper equipment can pose dangerous situations for workers, and can waste valuable work time. All equipment should be checked before use, and should be in good working order.

Protective measures should be taken to protect people working outside the confined space area. Barricades should be erected to protect passers-by from open person holes, hatch entrances and other unmarked entrances to the confined space area. In addition, care should be taken to prevent the accidental dropping of materials into the entrance of the confined space.

In case of contractors and subcontractors, all people working in a confined space environment will adhere to the requirements of the entry permit. Deviation from the standards set on the permit will necessitate immediate evacuation of the space.

RESPIRATORY PROTECTION

Once the atmosphere of a confined space has been analyzed, it is necessary to select the proper respiratory protection equipment for all entrants working within the confined space. Types of respirators recommended for confined space operations include Self-Contained Breathing Apparatus (SCBA), dual-purpose SCBA, combination air-line respirators with an escape cylinder, air-purifying devices and escape respirators. Because these devices vary in design, application and protective capability, it is important to first assess the level of contaminants at the work site. Equally important is up-to-date knowledge for the limitations of various respiratory protection devices to ensure proper selection.

Self-Contained Breathing Apparatus (SCBA)

SCBA provide the highest level of respiratory protection because they are designed to protect workers in oxygen-deficient atmospheres and/or in IDLH atmospheres found in confined space applications. SCBA are equipped with a user-worn air cylinder that offers a dependable, yet limited supply of air without any hoses or tethers to impede movement. SCBA are useful in confined space applications with entrances large enough to accommodate an entrant wearing the apparatus and the cylinder. Low-profile cylinders are available for tight confined space entrances. Under no circumstances should the entrant enter a confined space that contains a hazardous or potentially-hazardous atmosphere unprotected and wait to have SCBA equipment lowered to him or her.

One of the latest developments in SCBA technology is a cylinder refilling system which utilizes a special adapter. The adapter makes it possible to quickly refill an air cylinder while the unit is worn, providing the user with a virtually limitless air supply. This configuration also expands the range of uses for SCBA equipment as it eliminates the need to leave the confined space work area to access cascade-type refilling stations.

Combination-Type Dual-Purpose SCBA

Combination-type devices merge the capabilities of an air-line unit with those of an SCBA. Dual-purpose units differ from conventional SCBA in that they generally have a regulator with two inlet ports - one high-pressure (2216, 3000 or 4500 psig) port for permanent connection to the air cylinder and another low-pressure (85 psig) port for intermittent connection to an air-supply hose. The major advantage of these devices is that they offer the mobility of an SCBA when the air line is disconnected, but also offer the advantage of an extended air supply when the air line is used.

These types of respirators are especially suited for confined space applications. Confined space entrants can "plug" into a primary air source and have a long-duration, uninterrupted air supply. However, users have the option of relying on a 15-, 30-or 60-minute SCBA cylinder if they must move about or leave the confined space.

Supplied Air Respirator with Escape Cylinder

Like a dual-purpose SCBA, air-line respirators with escape cylinders "combine" the capabilities of an airline device with those of an SCBA. However, these devices differ from dual-purpose SCBA in that they generally are equipped with cylinders offering less service time-normally 5- or 10-minute-rated cylinders. Thus, the cylinder can be used for emergency escape purposes only. Supplied air respirators with escape cylinders offer an apparatus approved for entrance and exit from IDLH atmospheres except with the flexibility of a lower profile and lighter weight needed for confined spaces, for this reason they are commonly best suited for confined space rescue.

New technology has lead to the development of a unique "dual-supply" combination-type respirator. Equipped with a 5-minute-rated cylinder for emergency escape, the unit's regulator features ***two primary*** air inlets that permit a worker to switch from one air source to another without interrupting air flow and without diminishing the escape cylinder's air supply.

Using the respirator, workers can more easily enter a confined space while "transporting" their own personal air supply-usually a 30- or 60-minute-rated cylinder equipped with a carrying handle. The portable air supply technique works like this:

A worker first enters a confined space breathing via an air line from a larger air source, such as a 300-cubic foot cylinder, located outside the confined space, which is connected to one of the two regulator inlets. After entering the confined space, the "transportable" air cylinder is lowered to the worker using a work winch. The worker then connects to the transportable air source. With this connection made, the worker can disconnect from the original larger air cylinder, relying on the smaller tank as an air source while he or she explores the confined space.

Although this technique could be accomplished using a dual-purpose SCBA, the size and the position of the cylinder on the wearer's back can make it impractical for entering certain tight spaces.

Air-Purifying Respirators

Air-purifying respirators are designed for use **only** in atmospheres containing sufficient oxygen to sustain life (at lease 19.5 percent) and with known concentrations of gases, vapors and particulates. With these devices, special filter/chemical cartridges are used to remove specific gases, vapors, dusts, mists, and fumes from the ambient air. Thus, for the respirator to be effective, the level of contaminants must be within the concentration limitations of the specific respirator and filter. Generally, the useful life of air purifying respirator cartridges depends not only on the concentration of the contaminants, but also on the breathing volume of the user and the capacity of the air-purifying medium.

Because of the increased likelihood of oxygen deficiency and due to the possibility of concentrations of contaminants in confined spaces suddenly changing or not being fully known, air-purifying respirators should not be used for confined space entry unless known conditions exist and can be maintained.

Escape Respirators

Escape respirators provide a means of escape from IDLH atmospheres. These lightweight units generally are carried by the worker and feature a 5 minute air cylinder that delivers respirable air to the hood. Escape respirators must be able to provide a minimum air flow of 72 liters per minute. The hood is typically made of a flexible material, such as urethane, and can be used in temperatures as low as 0°F. For improved performance in chemical environments, transparent and flexible hoods manufactured from Teflon* are available. Escape respirators must **never** be used to **enter** a confined space. As their name implies, they are for escape only.

*Teflon is a trademark of the DuPont Company.

PROTECTIVE CLOTHING

Protective clothing can shield employees from a variety of hazards, including cuts, scrapes, splashes and leaching of chemicals into the skin. It can also help improve the safety of entry and exit from the confined space work area, and can help maintain body temperature. Made from a variety of materials, protective clothing comes in many styles, such as jackets, pants and coveralls, to accommodate specific work activities.

A wide range of garments is also available to help maintain and control the body temperature of entrants working in confined spaces. Heat stress can pose a major health problem, which can frequently go unrecognized. Due to the constricted nature of confined spaces, the impact of heat sources can be greatly increased. Designed to minimize the effects of heat stress, temperature control garments rely on ice packets or circulating fluids to absorb and dissipate body heat.

Head, Eye, Hearing and Hand Protection

Confined spaces often present hazards that require head, eye, hearing and hand protection. A wide variety of materials, is available for confined space applications. Special care should be taken to ensure that all areas of the body are protected before entering a confined space work area.

Head Protection

Head protection most commonly takes the form of a protective hat or cap and should meet the performance requirements of ANSI Z89.1-1986. Designed for top impact protection, as well as to dissipate the impact of bumping into stationary objects, protective headwear is frequently made of high density plastic. The hat or cap shell is supported by an inner suspension that creates an "impact space" between the crown of the user's head and the interior of the headwear. For maximum protection, no confined space worker should be allowed to enter the work area without head protection.

Eye Protection

Eye protection, in the form of protective spectacles with sideshields or goggles, helps shield workers' eyes from airborne debris. For additional protection, full faceshields are available to protect the eyes and other areas of the face from splashes and flying debris. Made for use with protective headgear, faceshields must be worn over suitable primary protectors such as spectacles or goggles.

Hearing Protection

Hearing protection equipment provides auditory protection from noises commonly generated in confined spaces. Due to their configuration, confined spaces tend to reverberate and amplify even small sounds, creating a serious auditory hazard for the worker. Aural protectors frequently take two forms; flexible plugs that insert into the worker's ear canals or ear muffs that cover each ear. Ear plugs or ear muffs should be worn in environments where cutting, grinding or high levels of mechanical noise are present. Muffs are worn with the headband. When head protection is worn, the headband fits under the chin or behind the head. Other models that snap into hard hats are also available.

Hand protection

Hand protection helps protect employees from caustics, acids and chemicals leaching into the skin. Hand protection also helps improve gripping in wet or slippery environments. Constructed as gloves or mitts, hand protection is available in a variety of materials to protect the user, such as vinyl for use in chemical environments. Gloves are frequently lined to provide moisture absorption, physical strength and added comfort.

COMMUNICATIONS EQUIPMENT

It is critical to have the correct communications equipment in any confined space work area. Reliable communications equipment allows workers to communicate between themselves as well as with the attendant stationed outside of the work area. In the event of an emergency, communications equipment allows help to be summoned quickly.

When working in a confined space atmosphere, contact must be maintained between the workers in the space and the attendant stationed outside. Battery-operated, voice-activated communications systems are frequently used, as they allow the worker to move freely in the confined space, and eliminate the need to hand-operate the communications device. Special care should be taken to ensure that batteries for all communications devices are in good working order, and that the range of the devices is sufficient for transmission from any part of the confined space work area. Lines of contact should also be established outside the confined space area to summon rescue personnel, if the need arises.

Personal Distress Devices, (PDD) are also useful in confined spaces where communication between workers and attendants is difficult. Designed to sound if the wearer does not move during a specified period of time, the alarm alerts other workers, as well as the attendant, that a worker is not moving and may have been overcome. This allows the attendant to clear the confined space and summon help.

LOWERING EQUIPMENT AND HARNESSES

To facilitate both entry into and exit from a confined space, it is necessary to have a proper retrieval system for both workers and equipment. Consisting of a heavy-duty lifeline, a tripod and personnel winch, retrieval equipment is useful in lowering workers into a confined space environment, as it controls the rate of descent and prevents accidental falls into the work area. Additional work winches are frequently used to raise and lower tools and equipment.

If an entrant must be quickly extracted from the confined space, lifting equipment employs the concepts of physics to raise the entrant out of the work area. Winches typically have a mechanical advantage of about 25:1, although mechanical advantage systems generating too much force to feel resistance, or powered equipment are never used due to the risk of injury to the entrant or victim. Without the use of mechanical advantage systems it would be nearly impossible to raise entrants. It is nearly impossible for an average person to pull someone out of a deep person hole without this mechanical advantage.

Some types of clothing are designed to offer protection as well as easy entrance and exit from the confined space work area. Coveralls, for example, have been designed with integral harnesses that allow lifting winches to be directly attached to the garment. This takes the confusion out of donning a full-body harness, allowing quick entry into the confined space.

A wide variety of harnesses is available for use with retrieval equipment. Many models are worn over the upper body or strapped over clothing. For emergencies in confined spaces with extremely tight openings, wrist-type harnesses allow downed workers to be quickly extracted from the work area by pulling the arms over the head and then raising the worker with a tripod and winch. This arrangement helps to protect the injured worker's head and reduces the possibility of the downed worker's shoulders catching on the entry port to the confined space.

Winches on lifting equipment should be outfitted with durable retrieval lines, and should be self-braking to prevent free falls and hold personnel in place when raising and lowering has stopped. Tripods should have two winches; one for lowering, arresting and retrieving a worker and a second winch for raising and lowering tools or equipment to the worker. This means a worker is **never** tempted to disconnect from his/her lifeline. Before making an entry into confined space work areas, all equipment should be carefully checked. **Harnesses or retrieval lines showing any signs of wear should not be used.**

TRAINING ENTRY PERSONNEL AND ATTENDANTS

Individuals authorizing entry into a confined space must have a complete knowledge of the contents and hazards within the space.

Every worker must fully understand their duties before ever working in the confined space or if there are changes in the assigned duties or confined space applications, the training must be certified. Specifically, the employer should ensure that confined space entrants are familiar with:

Hazard Recognition. The employer must let the entrant know what hazards are contained in the confined space, and the consequences of exposure to those hazards. In addition, the employer must inform the entrants of the signs and symptoms of exposure to the hazards contained in the confined space.

Communication. The employer must ensure that authorized entrants maintain contact with the attendant stationed outside the confined space work area. The attendant is alerted when the entrant recognizes a warning sign or symptom of exposure to a dangerous situation, or detects a prohibited condition.

Protective Equipment. The employer must make sure that employees have all necessary personal protective equipment and instruments, including external barriers to protect entrants from external hazards.

Entrants must be instructed in the proper use and donning of protective equipment, as well as the proper operation of instruments that must be used in the confined space. Specifically, each entrant needs to know what it is and how to use it properly, including use of communications equipment in order to maintain contact with the attendant and to notify co-workers of any hazardous situations or sudden changes within the confined space.

Self Rescue. The employer must ensure that there is safe entry and exit from the confined space work area. Entrants should leave the work area when:

1. The attendant orders evacuation
2. The entrants recognize a warning sign or symptom of exposure to a dangerous situation
3. The entrants detect a prohibited condition
4. An evacuation alarm is activated

Employees must become familiar with the procedures for self-rescue.

Role of the Entry Group Supervisor

Each permit required space entry will require an Entry Group Supervisor to be identified. The Entry Group Supervisor may or may not be present at the immediate entry site. His/her responsibility includes verifying that all requirements of the entry permit are met, as well as verifying that rescue services are available and supervising the attendant and entrants.

Role of the Attendant

All workers in a confined space must be observed by an attendant located outside the confined space work area. The attendant must remain on duty at all times during entry operations.

Specifically, the attendant must oversee:

Number of Entrants. It is the attendant's responsibility to maintain an accurate count of all workers in the confined space.

Hazard Recognition. The attendant must know and be able to recognize all potential hazards connected with the confined space. In addition, the attendant must monitor all conditions both inside and outside the confined space work area in order to determine if occupation of the confined space is safe.

Communications. The attendant must maintain effective and continuous contact with every entrant in the confined space during entry. In addition, it is the attendant's responsibility to order all entrants out of the space when:

- Conditions not allowed on the entry permit occur
- The attendant notices behavioral changes in the entrants
- An uncontrolled hazard within the permit space occurs
- The attendant notices a condition outside the permit space that could endanger entrants within the work area
- The attendant must leave his post in the event another confined space monitored by the attendant has an emergency

Securing the area. The attendant is also charged with keeping unauthorized personnel from entering the area. If unauthorized personnel enter the vicinity of the confined space area, it is the attendant's responsibility to instruct them to leave. If unauthorized personnel enter the confined space work area itself, the attendant must notify entrants, as well as supervisory personnel of their presence.

Coordinate Rescue. In the event a worker is overcome, the attendant must order all workers from the confined space, summon help and coordinate all necessary rescue efforts. Help may come from either in-house rescue or emergency services or a community emergency response team. The attendant may perform non-entry rescues as specified by the company's rescue procedure. **Under no circumstances should the attendant ever enter the confined space without a back-up attendant in place. More than 60% of all confined space fatalities occur because of an attendant or an unauthorized person rushing into the hazardous environment without protective equipment.**

Some companies outfit the attendant with the proper personal protective equipment and instruments necessary to make a rescue. In this situation, the attendant is "on stand-by" in the event that a rescue is necessary. However, in these situations, a rescue entry must not take place until a back-up attendant for the original attendant arrives.

After Entry is Complete

Once a confined space entry has been completed and all personnel have left the work area, the confined space should be secured and the entry permit canceled by the Entry Group Supervisor.

Records

Canceled entry permits, including notes of problems encountered, must be retained for at least one year. There must be an annual review of the permits, and the program revised as necessary. Comprehensive records documenting all training activities, safety drills, equipment inspections, atmospheric test results and equipment maintenance should be kept for every entry into a confined space area. These records will help ensure that proper procedures were followed, and that safety requirements of the confined space have been properly addressed.

Regulating Authorities

Within California the primary authority to enforce legal confined space entries is CAL-OSHA. The regulation that mandates our operations is Title 8 of the California Code of Regulations, General Industry Safety Orders, Section 5156, 5157 and 5158. This document is nearly a mirrored image of the federal OSHA document which was written based on many studies, some of which are taken from N.I.O.S.H and A.N.S.I. It is because of this compilation of information that it is well advised for employers to be concerned with complying with A.N.S.I. guidelines and N.I.O.S.H. guidelines as well as CAL-OSHA regulations.

CONFINED SPACE REGULATIONS

Reprint of Title 8 CCR GISO 5156, 5157 and 5158

State of California – Pete Wilson, Governor
Department of Industrial Relations – Lloyd W. Aubry Jr, Director
Division of Occupational Safety & Health

CONSULTATION CAL OSHA SERVICE

February 1994

CAL/OSHA CONSULTATION SERVICE

The Cal/OSHA Consultation Service provides free on-site consultation to employers, and advice and information regarding occupational safety and health to employee groups. The Consultation Service is not involved in Cal/OSHA enforcement activities.

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Phone95

CONFINED SPACE REGULATIONS

INDEX

REGULATION	CONTENT	PAGE
5156	Scope, Application and Definitions	4
5157	Permit-Required Confined Spaces	4
	(a) Scope and Application	4
	(b) Definitions	4
	(c) General Requirements	6
	(d) Permit-Required Confined Space Program	7
	(e) Permit System	9
	(f) Entry Permit	9
	(g) Training	9
	(h) Duties of Authorized Entrants	10
	(i) Duties of Attendants	10
	(j) Duties of Entry Supervisors	10
	(k) Rescue and Emergency Services	11
	APPENDICES	
	APPENDIX A. Permit Required Confined Space Decision Flow Chart	12
	B. Procedures for Atmospheric Testing	13
	C. Examples of Permit Required Confined Space Program	13
	D - 1 Confined Space Entry Permit	18
	D - 2 Entry Permit	19
	E. Sewer System Entry	20
5158	Other Confined Space Operations	
	(a) Scope	21
	(b) Definitions	21
	(c) Operating Procedures and Employee Training	21
	(d) Pre-Entry	21
	(e) Confined Space Operations	22

§ 5156. Scope, Application and Definitions.

(a) Scope. This Article prescribes minimum standards for preventing employee exposure to confined space hazards as defined by Section 5156(b), within such spaces as silos, tanks, vats, vessels, boilers, compartments, ducts, sewers, pipelines, vaults, bins, tubs, and pits.

NOTE: This Article does not apply to underwater operations conducted in diving bells or other underwater devices or to supervised hyperbaric facilities.

(b) Application and definitions.

(1) For operations and industries not identified in subsection (b)(2), the confined space definition along with other definitions and requirements of section 5157, Permit-Required Confined Spaces shall apply.

(2) The confined space definition along with other definitions and requirements of section 5158, Other Confined Space Operations shall apply to:

(A) Construction operations regulated by section 1502;
(B) Agriculture operations (including cotton gins) defined by section 3437;
(C) Marine terminal operations defined in section 3460;
(D) Shipyard operations regulated by section 8437;
(E) Telecommunication manholes and unvented vaults regulated by section 8616;
(F) Grain handling facilities regulated by section 5178.
(G) Natural gas utility operation within distribution and transmission facility vaults defined in Title 49 Code of Federal Regulations Parts 191, 192 and 193; or
(H) Electric utility operations within underground vaults. See section 2700 for a definition of vault.

Note: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§5157. Permit-Required Confined Spaces.

(a) Scope and application. This section contains requirements for practices and procedures to protect employees from the hazards of entry into permit-required confined spaces. This section applies to employers, as specified in section 5156(b)(1).

(b) Definitions.

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 means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

Authorized entrant means an employee who is authorized by the employer to enter a permit space.

Blanking or 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 of the pipe, line, or duct with no leakage beyond the plate.

Confined space means 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 (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and

(3) Is not designed for continuous employee occupancy.

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

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

Entry permit (permit) means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in subsection (f).

Entry supervisor means the person (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 by this section.

NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained anc equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

Hazardous atmosphere means 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:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);

(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

(4) Atmospheric concentration of any substance for which a dose is published in Group 14 for Radiation and Radioactivity or a permissible exposure limit is published in section 5155 for Airborne contaminants and which could result in employee exposure in excess of its dose or permissible exposure limit;

NOTE: An atmospheric 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.

(5) Any other atmospheric condition that is immediately dangerous to life or health.

NOTE: For air contaminants for which a dose is not published in Group 14 for Radiation and Radioactivity or a permissible exposure limit is not published in section 5155 for Airborne contaminants, other sources of information such as: Material Safety Data Sheets that comply with section 5194, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

Hot work permit means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

Immediately dangerous to life or health (IDLH) means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

NOTE: Some materials – hydrogen fluoride gas and cadmium vapor, for example – may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

Inerting means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

NOTE: This procedure produces an IDLH oxygen-deficient atmosphere.

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

Line breaking means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

Non-permit confined space means 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.

Oxygen deficient atmosphere means an atmosphere containing less than 19.5 percent oxygen by volume.

Oxygen enriched atmosphere means an atmosphere containing more than 23.5 percent oxygen by volume.

Permit-required confined space (permit space) means a confined space that has one or more of the following characteristics:

(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.

Permit-required confined space program (permit space program) means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

Permit system means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

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 designated to rescue employees from permit spaces.

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

Testing means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

NOTE: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

(c) General requirements.

(1) The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.

NOTE: Proper application of the decision flow chart in Appendix A would facilitate compliance with this requirement.

(2) If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

NOTE: A sign reading "DANGER – PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" or using other similar language would satisfy the requirement for a sign.

(3) If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with subsections (c)(1), (c)(2), (c)(6), and (c)(8).

(4) If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

(5) An employer may use the alternate procedures specified in subsection (c)(5)(B) for entering a permit space under the conditions set forth in subsection (c)(5)(A).

(A) An employer whose employees enter a permit space need not comply with subsections (d) through (f) and (h) through (k), provided that:

1. The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

2. The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

3. The employer develops monitoring and inspection data that supports the demonstrations required by subsections (c)(5)(A)1. and 2.;

4. If an initial entry of the permit space is necessary to obtain the data required by subsection (c)(5)(A)3., the entry is performed in compliance with subsections (d) through (k);

5. The determinations and supporting data required by subsections (c)(5)(A)1., 2. and 3. are documented by the employer and are made available to each employee who enters the permit space under the terms of subsection (c)(5); and

6. Entry into the permit space under the terms of subsection (c)(5)(A) is performed in accordance with the requirements of subsection (c)(5)(B).

NOTE: See subsection (c)(7) for reclassification of a permit space after all hazards within the space have been eliminated.

(B) The following requirements apply to entry into permit spaces that meet the conditions set forth in subsection (c)(5)(A).

1. Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

2. When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

3. Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for the following conditions in the order given:

a. Oxygen content,

b. Flammable gases and vapors, and

c. Potential toxic air contaminants.

4. There may be no hazardous atmosphere within the space whenever any employee is inside the space.

5. Continuous forced air ventilation shall be used, as follows:

a. An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

b. The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space;

c. The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

6. The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere.

7. If a hazardous atmosphere is detected during entry:

a. Each employee shall leave the space immediately;

b. The space shall be evaluated to determine how the hazardous atmosphere developed; and

c. Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

8. The employer shall verify that the space is safe for entry and that the pre-entry measures required by subsection (c)(5)(B) have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space.

(6) When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

(7) A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

(A) If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

(B) If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under subsections (d) through (k). If testing and inspection during that entry demonstrate 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.

NOTE: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Subsection (c)(5) covers permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

(C) The employer shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space.

(D) If hazards arise within a permit space that has been declassified to a non-permit space under subsection (c)(7), each employee in the space shall exit the space. The employer shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this section.

(8) When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

(A) Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

(B) Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

(C) Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

(D) Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by subsection (d)(11); and

(E) Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

(9) In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

(A) Obtain any available information regarding permit space hazards and entry operations from the host employer;

(B) Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by subsection (d)(11); and

(C) Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

(d) Permit-required confined space program (permit space program). Under the permit-required confined space program required by subsection (c)(4), the employer shall:

(1) Implement the measures necessary to prevent unauthorized entry;

(2) Identify and evaluate the hazards of permit spaces before employees enter them;

(3) Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

(A) Specifying acceptable entry conditions;

(B) Isolating the permit space;

(C) Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

(D) Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

(E) Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

(4) Provide the following equipment (specified in subsections (A) through (I), below) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

(A) Testing and monitoring equipment needed to comply with subsection (d)(5);

(B) Ventilating equipment needed to obtain acceptable entry conditions;

(C) Communications equipment necessary for compliance with subsections (h)(3) and (i)(5);(D) Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;

(E) Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

(F) Barriers and shields as required by subsection (d)(3)(D);

(G) Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;

(H) Rescue and emergency equipment needed to comply with subsection (d)(9), except to the extent that the equipment is provided by rescue services; and

(I) Any other equipment necessary for safe entry into and rescue from permit spaces.

(5) Evaluate permit space conditions as follows when entry operations are conducted:

(A) Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

(B) Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and

(C) When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

NOTE: Atmospheric testing conducted in accordance with Appendix B would be considered as satisfying the requirements of this subsection. For permit space operations in sewers, atmospheric testing conducted in accordance with Appendix B, as supplemented by Appendix E, would be considered as satisfying the requirements of this subsection.

(6) Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;

NOTE: Attendants may be assigned to monitor more than one permit space provided the duties described in subsection (i) can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in subsection (i) can be effectively performed for each permit space that is monitored.

(7) If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under subsection (i);

(8) Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required by subsection (g);

(9) Develop and implement procedures for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, for summoning additional rescue and emergency services, and for preventing unauthorized personnel from attempting a rescue;

(10) Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;

(11) Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer;

(12) Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;

(13) Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and

NOTE: Examples of circumstances requiring the review of the permit space program are: any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

(14) Review the permit space program, using the canceled permits retained under subsection (e)(6) within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

NOTE: Employers may perform a single annual review covering all entries performed during a 12-month period. If no entry is performed during a 12-month period, no review is necessary.

Appendix C presents examples of permit space programs that are considered to comply with the requirements of subsection (d).

(e) Permit system.

(1) Before entry is authorized, the employer shall document the completion of measures required by subsection (d)(3) by preparing an entry permit.

NOTE: Appendix D presents examples of permits whose elements are considered to comply with the requirements of this section

(2) Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

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

(4) The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with subsection (f)(2).

(5) The entry supervisor shall terminate entry and cancel the entry permit when:

(A) The entry operations covered by the entry permit have been completed; or

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

(6) The employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit space program required by subsection (d)(14). Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

(f) Entry permit. The entry permit that documents compliance with this section and authorizes entry to a permit space shall identify:

(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;

NOTE: This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

(5) The personnel, by name, currently serving as attendants;

(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 hazards of the permit space to be entered;

(8) The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;

NOTE: Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

(9) The acceptable entry conditions;

(10) The results of initial and periodic tests performed under subsection (d)(5), 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 provided on-site and additional services that can be summoned and the means (such as the equipment to use and the numbers 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; and

(15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

(g) Training.

(1) The employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this section.

(2) Training shall be provided to each affected employee:

(A) Before the employee is first assigned duties under this section;

(B) Before there is a change in assigned duties;

(C) Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

(D) Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by subsection (d)(3) or that there are inadequacies in the employee's knowledge or use of these procedures.

(3) The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

(4) The employer shall certify that the training required by subsections (g)(1) through (g)(3) has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.

(h) **Duties of authorized entrants.** 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 subsection (d)(4);

(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 subsection (i)(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; and

(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.

(i) **Duties of attendants.** The employer shall ensure that each attendant:

(1) 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 subsection (f)(4) accurately identifies who is in the permit space;

(4) Remains outside the permit space during entry operations until relieved by another attendant;

NOTE: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by subsection (k)(1) and if they have been relieved as required by subsection (i)(4).

(5) Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under subsection (i)(6);

(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; or

(D) If the attendant cannot effectively and safely perform all the duties required under subsection (i);

(7) Initiate on-site rescue procedures and, if necessary, summon additional 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; and

(C) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

(9) Performs non-entry rescues or other rescue services as part of the employer's on-site rescue procedure; and

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

(j) **Duties of entry supervisors.** The employer shall ensure that each entry supervisor:

(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 subsection (e)(5);

(4) Verifies that rescue services are available and that the means for summoning additional services are operable;

(5) Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

(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.

(k) **Rescue and emergency services.** The employer shall ensure that at least one standby person at the site is trained and immediately available to perform rescue and emergency services.

(1) The following requirements apply to employers who have employees enter permit spaces to perform rescue services.

(A) The employer shall ensure that each member of the rescue service is provided with, and is trained to use properly, the personal protective equipment and rescue equipment necessary for making rescues from permit spaces.

(B) Each member of the rescue service shall be trained to perform the assigned rescue duties. Each member of the rescue service shall also receive the training required of authorized entrants under subsection (g).

(C) Each member of the rescue service shall practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

(D) Each member of the rescue service shall be trained in basic first-aid and in cardiopulmonary resuscitation (CPR). At least one member of the rescue service holding current certification in first aid and in CPR shall be available.

(2) When an employer (host employer) arranges to have persons other than the host employer's employees perform permit space rescue, the host employer shall:

(A) Inform the rescue service of the hazards they may confront when called on to perform rescue at the host employer's facility, and

(B) Provide the rescue service with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

(3) To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

(A) Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at a suitable point so that when rescued, the entrant presents the smallest possible profile (for example at the center of the entrant's back near shoulder level, or above the entrant's head). Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

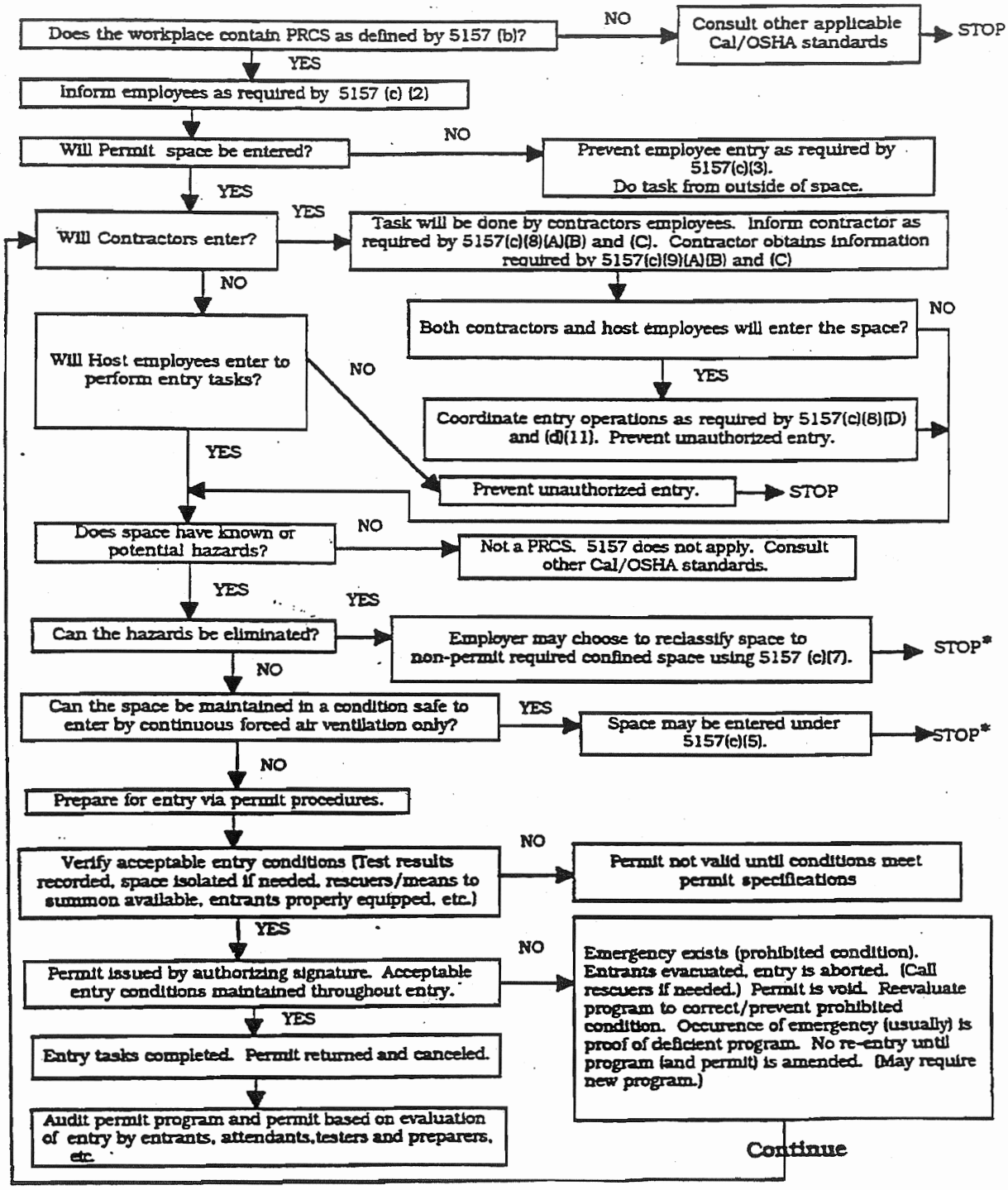
(B) The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet deep.

(4) If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

APPENDICES. Appendices A through E serve to provide information and non-mandatory guidelines to assist employers and employees in complying with the appropriate requirements of this section.

Appendix A. Permit - Required Confined Space (PRCS) Decision Flow Chart



* Spaces may have to be evacuated and re-evaluated if hazards arise during entry.

Appendix B -- Procedures for Atmospheric Testing.

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

(1) Evaluation testing. The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space. Evaluation and interpretation of these data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., Cal/OSHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.) based on evaluation of all serious hazards.

(2) Verification testing. The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. Results of testing (i.e., actual concentration, etc.) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

(3) Duration of testing. Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.

(4) Testing stratified atmospheres. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.

(5) Order of testing. A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life theratening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

Appendix C - Examples of Permit-required Confined Space Programs.

Example 1.

Workplace. Sewer entry.

Potential hazards. The employees could be exposed to the following:

Engulfment.

Presence of toxic gases. Equal to or more than 10 ppm hydrogen sulfide as measured as an 8-hour time weighted average. If the presence of other toxic contaminants is suspected, specific monitoring programs will be developed.

Presence of explosive/flammable gases. Equal to or greater than 10% of the lower flammable limit (LFL).

Oxygen Deficiency. A concentration of oxygen in the atmosphere equal to or less than 19.5% by volume.

A. ENTRY WITHOUT PERMIT/ATTENDANT

Certification. Confined spaces may be entered without the need for a written permit or attendant provided that the space can be maintained in a safe condition for entry by mechanical ventilation alone as provided in Section 5157(c)(5). All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter an enclosed/confined space shall have successfully completed, as a minimum, the training as required by the following sections of these procedures. A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job. The Confined Space Pre-Entry Check List must be completed by the LEAD WORKER before entry into a confined space. This list verifies completion of items listed below. This check list shall be kept at the job site for duration of the job. If circumstances dictate an interruption in the work, the permit space must be re-evaluated and a new check list must be completed.

Control of atmospheric and engulfment hazards.

Pumps and Lines. All pumps and lines which may reasonably cause contaminants to flow into the space shall be disconnected, blinded and locked out, or effectively isolated by other means to prevent development of dangerous air contamination or engulfment. Not all laterals to sewers or storm drains require blocking. However, where experience or knowledge of industrial use indicates there is a reasonable potential for contamination of air or engulfment into an occupied sewer, then all affected laterals shall be blocked. If blocking and/or isolation requires entry into the space the provisions for entry into a permit-required confined space must be implemented.

Surveillance. The surrounding area shall be surveyed to avoid hazards such as drifting vapors from the tanks, piping, or sewers.

Testing. The atmosphere within the space will be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. Detector tubes, alarm only type gas monitors and explosion meters are examples of equipment that may be used to test permit space atmospheres. Testing shall be performed by the LEAD WORKER who has successfully completed the Gas Detector training for the monitors he will use. The minimum parameters to be monitored are oxygen deficiency, LFL, and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. The supervisor will certify in writing, based upon the results of the pre-entry testing, that all hazards have been eliminated. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connecting spaces.

Entry Procedures. If there are no non-atmospheric hazards present and if the pre-entry tests show there is no dangerous air contamination and/or oxygen deficiency within the space and there is no reason to believe that any is likely to develop, entry into and work within may proceed. Continuous testing of the atmosphere in the immediate vicinity of the workers within the space shall be accomplished. The workers will immediately leave the permit space when any of the gas monitor alarm set points are reached as defined. Workers will not return to the area until a SUPERVISOR who has completed the gas detector training has used a direct reading gas detector to evaluate the situation and has determined that it is safe to enter.

Rescue. Arrangements for rescue services are not required where there is no attendant. See the rescue portion of section B., below, for instructions regarding rescue planning where an entry permit is required.

B. ENTRY PERMIT REQUIRED

Permits. Confined Space Entry Permit. All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter a permit-required confined space shall have successfully completed, as a minimum, the training as required by the following sections of these procedures. A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job. The Confined Space Entry Permit must be completed before approval can be given to enter a permit-required confined space. This permit verifies completion of items listed below. This permit shall be kept at the job site for the duration of the job. If circumstances cause an interruption in the work or a change in the alarm conditions for which entry was approved, a new Confined Space Entry Permit must be completed.

Control of atmospheric and engulfment hazards.

Surveillance. The surrounding area shall be surveyed to avoid hazards such as drifting vapors from tanks, piping or sewers.

Testing. The confined space atmosphere shall be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. A direct reading gas monitor shall be used. Testing shall be performed by the SUPERVISOR who has successfully completed the gas detector training for the monitor he will use. The minimum parameters to be monitored are oxygen deficiency, LFL and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connected spaces.

Space Ventilation. Mechanical ventilation systems, where applicable, shall be set at 100% outside air. Where possible, open additional manholes to increase air circulation. Use portable blowers to augment natural circulation if needed. After a suitable ventilating period, repeat the testing. Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated.

Entry Procedures. The following procedure shall be observed under any of the following conditions:

1.) Testing demonstrates the existence of dangerous or deficient conditions and additional ventilation cannot reduce concentrations to safe levels;

2.) The atmosphere tests as safe but unsafe conditions can reasonably be expected to develop;

3.) It is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems and it is not practical or safe to deactivate such systems; or

4.) An emergency exists and it is not feasible to wait for pre-entry procedures to take effect.

All personnel must be trained. A self contained breathing apparatus shall be worn by any person entering the space. At least one worker shall stand by the outside of the space ready to give assistance in case of emergency. The standby worker shall have a self contained breathing apparatus available for immediate use. There shall be at least one additional worker within sight or call of the standby worker. Continuous powered communications shall be maintained between the worker within the confined space and standby personnel.

If at any time there is any questionable action or non-movement by the worker inside, a verbal check will be made. If there is no response, the worker will be moved immediately. Exception: If the worker is disabled due to falling or impact, he/she shall not be removed from the confined space unless there is immediate danger to his/her life. Local fire department rescue personnel shall be notified immediately. The standby worker may only enter the confined space in case of an emergency (wearing the self contained breathing apparatus) and only after being relieved by another worker. Safety belt or harness with attached lifeline shall be used by all workers entering the space with the free end of the line secured outside the entry opening. The standby worker shall attempt to remove a disabled worker via his lifeline before entering the space.

When practical, these spaces shall be entered through side openings -- those within 3 ½ feet (1.07 m) of the bottom. When entry must be through a top opening, the safety belt shall be of the harness type that suspends a person upright and a hoisting device or similar apparatus shall be available for lifting workers out of the space.

In any situation where their use may endanger the worker, use of a hoisting device or safety belt and attached lifeline may be discontinued.

When dangerous air contamination is attributable to flammable and/or explosive substances, lighting and electrical equipment shall be Class 1, Division 1 rated per National Electrical Code and no ignition sources shall be introduced into the area.

Continuous gas monitoring shall be performed during all confined space operations. If alarm conditions change adversely, entry personnel shall exit the confined space and a new confined space permit issued.

Rescue. Call the fire department services for rescue. Where immediate hazards to injured personnel are present, workers at the site shall implement emergency procedures to fit the situation.

Example 2.

Workplace. Meat and poultry rendering plants.

Cookers and dryers are either batch or continuous in their operation. Multiple batch cookers are operated in parallel. When one unit of a multiple set is shut down for repairs, means are available to isolate that unit from the others which remain in operation.

Cookers and dryers are horizontal, cylindrical vessels equipped with a center, rotating shaft and agitator paddles or discs. If the inner shell is jacketed, it is usually heated with steam at pressures up to 150 psig (1034.25 kPa). The rotating shaft assembly of the continuous cooker or dryer is also steam heated.

Potential Hazards. The recognized hazards associated with cookers and dryers are the risk that employees could be:

1. Struck or caught by rotating agitator;
2. Engulfed in raw material or hot, recycled fat;
3. Burned by steam from leaks into the cooker/dryer steam jacket or the condenser duct system if steam valves are not properly closed and locked out;
4. Burned by contact with hot metal surfaces, such as the agitator shaft assembly, or inner shell of the cooker/dryer;
5. Heat stress caused by warm atmosphere inside cooker/dryer;
6. Slipping and falling on grease in the cooker/dryer;
7. Electrically shocked by faulty equipment taken into the cooker/dryer;
8. Burned or overcome by fire or products of combustion; or
9. Overcome by fumes generated by welding or cutting done on grease covered surfaces.

Permits. The supervisor in this case is always present at the cooker/dryer or other permit entry confined space when entry is made. The supervisor must follow the pre-entry isolation procedures described in the entry permit in preparing for entry, and ensure that the protective clothing, ventilating equipment and any other equipment required by the permit are at the entry site.

Control of hazards.

Mechanical. Lock out main power switch to agitator motor at main power panel. Affix tag to the lock to inform others that a permit entry confined space entry is in progress.

Engulfment. Close all valves in the raw material blow line. Secure each valve in its closed position using chain and lock. Attach a tag to the valve and chain warning that a permit entry confined space entry is in progress. The same procedure shall be used for securing the fat recycle valve.

Burns and heat stress. Close steam supply valves to jacket and secure with chains and tags. Insert solid blank at flange in cooker vent line to condenser manifold duct system. Vent cooker/dryer by opening access door at discharge end and top center door to allow natural ventilation throughout the entry. If faster cooling is needed, use a portable ventilation fan to increase ventilation. Cooling water may be circulated through the jacket to reduce both outer and inner surface temperatures of cooker/dryers faster. Check air and inner surface temperatures in cooker/dryer to assure they are within acceptable limits before entering, or use proper protective clothing.

Fire and fume hazards. Careful site preparation, such as cleaning the area within 4 inches (10.16 cm) of all welding or torch cutting operations, and proper ventilation are the preferred controls. All welding and cutting operations shall be done in accordance with the requirements of California Code of Regulations, Title 8, welding standards. Proper ventilation may be achieved by local exhaust ventilation, or the use of portable ventilation fans, or a combination of the two practices.

Electrical shock. Electrical equipment used in cooker/dryers shall be in serviceable condition.

Slips and falls. Remove residual grease before entering cooker/dryer.

Attendant. The supervisor shall be the attendant for employees entering cooker/dryers.

Permit. The permit shall specify how isolation shall be done and any other preparations needed before making entry. This is especially important in parallel arrangements of cooker/dryers so that the entire operation need not be shut down to allow safe entry into one unit.

Rescue. When necessary, the attendant shall call the fire department as previously arranged.

Permits. An entry permit valid for up to 1 year shall be issued prior to authorization of entry into used tank trailers, dry bulk trailers or trucks. In addition to the pre-entry cleaning requirement, this permit shall require the employee safeguards specified for new tank fabrication or construction permit areas.

Authorization. Only the area supervisor may authorize an employee to enter a tank trailer, dry bulk trailer or truck within the permit area. The area supervisor must determine that the entry permit requirements have been met before authorizing entry.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

Example 3.

Workplace. Workplaces where tank cars, trucks, and trailers, dry bulk tanks and trailers, railroad tank cars, and similar portable tanks are fabricated or serviced.

A. During fabrication. These tanks and dry-bulk carriers are entered repeatedly throughout the fabrication process. These products are not configured identically, but the manufacturing processes by which they are made are very similar.

Sources of hazards. In addition to the mechanical hazards arising from the risks that an entrant would be injured due to contact with components of the tank or the tools being used, there is also the risk that a worker could be injured by breathing fumes from welding materials or mists or vapors from materials used to coat the tank interior. In addition, many of these vapors and mists are flammable, so the failure to properly ventilate a tank could lead to a fire or explosion.

Control of hazards.

Welding. Local exhaust ventilation shall be used to remove welding fumes once the tank or carrier is completed to the point that workers may enter and exit only through a manhole. (Follow the requirements of California Code of Regulations, Title 8, welding standards at all times.) Welding gas tanks may never be brought into a tank or carrier that is a permit entry confined space.

Application of interior coatings/linings. Atmospheric hazards shall be controlled by forced air ventilation sufficient to keep the atmospheric concentration of flammable materials below 10% of the lower flammable limit (LFL) (or lower explosive limit (LEL), whichever term is used locally). The appropriate respirators are provided and shall be used in addition to providing forced ventilation if the forced ventilation does not maintain acceptable respiratory conditions.

Permits. Because of the repetitive nature of the entries in these operations, an "Area Entry Permit" will be issued for a 1 month period to cover those production areas where tanks are fabricated to the point that entry and exit are made using manholes.

Authorization. Only the area supervisor may authorize an employee to enter a tank within the permit area. The area supervisor must determine that conditions in the tank trailer, dry bulk trailer or truck, etc. meet permit requirements before authorizing entry.

Attendant. The area supervisor shall designate an employee to maintain communication by employer specified means with employees working in tanks to ensure their safety. The attendant may not enter any permit entry confined space to rescue an entrant or for any other reason, unless authorized by the rescue procedure and, and even then, only after calling the rescue team and being relieved by as attendant by another worker.

Communications and observation. Communications between attendant and entrant(s) shall be maintained throughout entry. Methods of communication that may be specified by the permit include voice, voice powered radio, tapping or rapping codes on tank walls, signalling tugs on a rope, and the attendant's observation that work activities such as chipping, grinding, welding, spraying, etc., which require deliberate operator control continue normally. These activities often generate so much noise that the necessary hearing protection makes communication by voice difficult.

Rescue procedures. Acceptable rescue procedures include entry by a team of employee-rescuers, use of public emergency services, and procedures for breaching the tank. The area permit specifies which procedures are available, but the area supervisor makes the final decision based on circumstances. (Certain injuries may make it necessary to breach the tank to remove a person rather than risk additional injury by removal through an existing manhole. However, the supervisor must ensure that no breaching procedure used for rescue would violate terms of the entry permit. For instance, if the tank must be breached by cutting with a torch, the tank surfaces to be cut must be free of volatile or combustible coatings within 4 inches (10.16 cm) of the cutting line and the atmosphere within the tank must be below the LFL.

Retrieval line and harnesses. The retrieval lines and harnesses generally required under this standard are usually impractical for use in tanks because the internal configuration of the tanks and their interior baffles and other structures would prevent rescuers from hauling out injured entrants. However, unless the rescue procedure calls for breaching the tank for rescue, the rescue team shall be trained in the use of retrieval lines and harnesses for removing injured employees through manholes.

B. Repair or service of "used" tanks and bulk trailers.

Sources of hazards. In addition to facing the potential hazards encountered in fabrication or manufacturing, tanks or trailers which have been in service may contain residues of dangerous materials, whether left over from the transportation of hazardous cargoes or generated by chemical or bacterial action on residues of non-hazardous cargoes.

Control of atmospheric hazards. A "used" tank shall be brought into areas where tank entry is authorized only after the tank has been emptied, cleansed (without employee entry) of any residues, and purged of any potential atmospheric hazards.

Welding. In addition to tank cleaning for control of atmospheric hazards, coating and surface materials shall be removed 4 inches (10.16 cm) or more from any surface area where welding or other torch work will be done and care taken that the atmosphere within the tank remains well below the LFL. (Follow the requirements of California Code of Regulations, Title 8, welding standards, at all times.)

Appendix D - 1 Confined Space Entry Permit

Confined Space Entry Permit

Date and Time Issued:_____

Job Site/Space ID _____

Equipment to be worked on:_____

Standby personnel:_____

_____

Date and Time Expires:_____

Job supervisor:_____

Work to be performed:_____

1. Atmospheric Checks: Time ____
   Oxygen____% Explosive ____% L.F.L.
   Toxic ____ PPM
2. Tester's signature:_____
3. Source isolation (No Entry):

	N/A	Yes	No
Pumps or lines blinded.	( )	( )	( )
disconnected, or blocked	( )	( )	( )

4. Ventilation Modification:

	N/A	Yes	No
Mechanical	( )	( )	( )
Natural Ventilation only	( )	( )	( )

5. Atmospheric check after isolation and Ventilation:

Oxygen_____%	≥	19.5 %
Explosive____% L.F.L.	≤	10 %
Toxic____ PPM	≤	10 PPM H_2S

   Time _____
   Tester's Signature _____
6. Communications Procedures:
7. Rescue Procedures:
8. Entry, Standby, and back up persons:

	Yes	No
Successfully completed required training?	( )	( )
Is it current?	( )	( )

9. Equipment:

	N/A	Yes	No
direct reading gas monitor tested	( )	( )	( )
Safety harnesses and lifelines for entry and standby persons	( )	( )	( )
Hoisting equipment	( )	( )	( )
Powered communications	( )	( )	( )
SCBA's for entry and standby persons	( )	( )	( )
Protective Clothing	( )	( )	( )
All electric equipment listed Class I, Division I, Group D and Non-sparking tools	( )	( )	( )

10. Periodic atmospheric tests:
    Oxygen:_____ % Time: _____
    Explosive: ___ % Time: _____
    Toxic: _____ppm Time: _____

We have reviewed the work authorized by this permit and the information contained here-in. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any items are marked in the "No" column. This permit is not valid unless all appropriate items are completed.

Permit Prepared By: (Supervisor)_____

Approved By: (Unit Supervisor) _____

Reviewed By (Confined Space Operations Personnel) : (printed name & signature)

_____

This permit to be kept at job site. Return job site copy to Safety office following job completion.

Copies: White Original (Safety Office) Yellow (Unit Supervisor) Hard (Job site):

Appendix D - 2 Entry Permit

ENTRY PERMIT

PERMIT VALID FOR 8 HOURS ONLY. ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED
DATE:_____ SITE LOCATION and DESCRIPTION_____
PURPOSE OF ENTRY _____
SUPERVISOR(S) in charge of crews Type of Crew Phone #_____
Communication Procedures: _____
Rescue Procedures (phone # at bottom) :_____
* BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY*

REQUIREMENTS COMPLETED	DATE	TIME	REQUIREMENTS COMPLETED	DATE	TIME
Lock Out/De-energize/Try-out	___	___	Full Body Harness w/"D" ring	___	___
Line(s) Broken-Capped-Blanked	___	___	Emergency Escape Retrieval Equip.	___	___
Purge-Flush and Vent	___	___	Lifelines	___	___
Ventilation	___	___	Fire Extinguishers	___	___
Secure area (Post and Flag)	___	___	Lighting (Explosive Proof)	___	___
Breathing Apparatus	___	___	Protective Clothing	___	___
Resuscitator - Inhalator	___	___	Respirator(s) (Air Purifying)	___	___
Standby Safety Personnel	___	___	Burning and Welding Permit	___	___

Note: Items that do not apply enter N/A in the blank.

** RECORD CONTINUOUS MONITORING RESULTS EVERY 2 HOURS **

CONTINUOUS MONITORING TEST(S) TO BE TAKEN	PERMISSIBLE ENTRY LEVEL	MONITORING RESULTS EVERY 2 HOURS							
PERCENT OF OXYGEN	19.5% to 23.5%	___	___	___	___	___	___	___	___
LOWER FLAMMABLE LIMIT	Under 10%	___	___	___	___	___	___	___	___
CARBON MONOXIDE	35 PPM	___	___	___	___	___	___	___	___
Aromatic Hydrocarbon	1 ppm - 5 ppm	___	___	___	___	___	___	___	___
Hydrogen Cyanide	4.7 ppm (S)	___	___	___	___	___	___	___	___
Hydrogen Sulphide	10 ppm+ 15 ppm*	___	___	___	___	___	___	___	___
Sulphur Dioxide	2 ppm+ 5 ppm*	___	___	___	___	___	___	___	___
Ammonia	25 ppm+ 35 ppm*	___	___	___	___	___	___	___	___

* Short-term exposure limit: Employee can work in the area up to 15 minutes.
+ 8 hr. Time Weighted Avg.: Employee can work in are 8 hrs (longer with appropriate respiratory protection).
REMARKS: _____

GAS TESTER NAME & CHECK #	INSTRUMENT(S) USED	MODEL &/OR TYPE	SERIAL &/OR UNIT #
_____	_____	_____	_____
_____	_____	_____	_____

SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED SPACE WORK

SAFETY STANDBY PERSON(S)	CHECK #	CONFINED SPACE ENTRANT	CHECK #
_____	___	_____	_____
_____	___	_____	_____

SUPERVISOR AUTHORIZATION - AMBULANCE# _____ FIRE# _____
ALL CONDITIONS SATISFIED _____ Safety Off# _____ Gas Coordinator# _____
DEPARTMENT _____ Phone _____

Appendix E – Sewer System Entry.

Sewer entry differs in three vital respects from other permit entries; first, there rarely exists any way to completely isolate the space (a section of a continuous system) to be entered; second, because isolation is not complete, the atmosphere may suddenly and unpredictably become lethally hazardous (toxic, flammable or explosive) from causes beyond the control of the entrant or employer, and third experienced sewer workers are especially knowledgeable in entry and work in their permit spaces because of their frequent entries Unlike other employments where permit space entry is a rare and exceptional event, sewer workers' usual work environment is a permit space.

(1) Adherence to procedure. The employer should designate as entrants only employees who are thoroughly trained in the employer's sewer entry procedures and who demonstrate that they follow these entry procedures exactly as prescribed when performing sewer entries.

(2) Atmospheric monitoring. Entrants should be trained in the use of, and be equipped with, atmospheric monitoring equipment which sounds an audible alarm, in addition to its visual readout, whenever one of the following conditions is encountered: oxygen concentration less than 19.5 percent; flammable gas or vapor at 10 percent or more of the lower flammable limit (LFL); or hydrogen sulfide or carbon monoxide at or above their permissible exposure limit (PEL) (10 ppm or 35 ppm, respectively, measured as an 8-hour time weighted average (TWA)). Atmospheric monitoring equipment needs to be calibrated according to the manufacturer's instructions. Substance specific devices should be used whenever actual contaminants have been identified. The instrument should be carried and used by the entrant in sewer line work to monitor the atmosphere in the entrant's environment, and in advance of the entrants' direction of movement, to warn the entrant of any deterioration in atmospheric conditions. Where several entrants are working together in the same immediate location, one instrument, used by the lead entrant, is acceptable.

(3) Surge flow and flooding. Sewer crews should develop and maintain liaison, to the extent possible, with the local weather bureau and fire and emergency services in their area so that sewer work may be delayed or interrupted and entrants withdrawn whenever sewer lines might be suddenly flooded by rain or fire suppression activities, or whenever flammable or other hazardous materials are released into sewers during emergencies by industrial or transportation accidents.

(4) Special Equipment. Entry into large bore sewers may require the use of special equipment. Such equipment might include such items as atmosphere monitoring devices with automatic audible alarms, escape self-contained breathing apparatus (ESCBA) with at least 10 minute air supply (or other NIOSH approved self-rescuer), and waterproof flashlights, and may also include boats and rafts, radios and rope stand-offs for pulling around bends and corners as needed.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§5158. Other Confined Space Operations.

(a) Scope. For industries and operations specified in section 5156(b)(2) this section prescribes minimum standards for preven employee exposure to dangerous air contamination and/or oxygen deficiency in confined spaces, as defined in subsection (b).

(b) Definitions.

(1) Confined Space. A space defined by the concurrent existence of the following conditions:

(A) Existing ventilation is insufficient to remove dangerous air contamination and/or oxygen deficiency which may exist or develop.

(B) Ready access or egress for the removal of a suddenly disabled employee is difficult due to the location and/or size of the opening(s).

(2) Dangerous Air Contamination. An atmosphere presenting a threat of causing death, injury, acute illness, or disablement due to the presence of flammable and/or explosive, toxic, or otherwise injurious or incapacitating substances.

(A) Dangerous air contamination due to the flammability of a gas or vapor is defined as an atmosphere containing the gas or vapor at a concentration greater than 20 percent of its lower explosive (lower flammable) limit.

(B) Dangerous air contamination due to a combustible particulate is defined as a concentration greater than 20 percent of the minimum explosive concentration of the particulate.

(C) Dangerous air contamination due to the toxicity of a substance is defined as the atmospheric concentration immediately hazardous to life or health.

NOTE: This definition of dangerous air contamination due to the toxicity of a substance does not preclude the requirement to contr harmful exposures, under the provisions of Article 107, to toxic substances at concentrations less than those immediately hazardous to life or health.

(3) Oxygen Deficiency. An atmosphere containing oxygen at a concentration of less than 19.5 percent by volume.

(c) Operating Procedures and Employee Training. The employer shall implement the provisions of this subsection before an employee is permitted to enter a confined space.

(1) Operating Procedures.

(A) Written, understandable operating and rescue procedures shall be developed and shall be provided to affected employees.

(B) Operating procedures shall conform to the applicable requirements of this section and shall include provision for the surveillance of the surrounding area to avoid hazards such as drifting vapors from tanks, piping and sewers.

(2) Employee Training. Employees, including standby persons required by subsection (e)(1)(D), shall be trained in the operating and rescue procedures, including instructions as to the hazards they may encounter.

(d) Pre-entry. The applicable provisions of this subsection shall be implemented before entry into a confined space.

(1) Lines which may convey flammable, injurious, or incapacitating substances into the space shall be disconnected, blinded, or blocked off by other positive means to prevent the development of dangerous air contamination and/or oxygen deficiency within the space. The disconnection or blind shall be so located or done in such a manner that inadvertent reconnection of the line or removal of the blind are effectively prevented.

EXCEPTION: This subsection does not apply to public utility gas distribution systems.

NOTE: This subsection does not require blocking of all laterals to sewers or storm drains. Where experience or knowledge of industrial use indicates materials resulting in dangerous air contamination may be dumped into an occupied sewer, all such laterals shall be blocked.

(2) The space shall be emptied, flushed, or otherwise purged of flammable, injurious or incapacitating substances to the extent feasible.

(3) The air shall be tested with an appropriate device or method to determine whether dangerous air contamination and/or an oxygen deficiency exists and a written record of such testing results shall be made and kept at the work site for the duration of the work. Affected employees and/or their representative shall be afforded an opportunity to review and record the testing results.

(4) Where interconnected spaces are blinded off as a unit, each space shall be tested and the results recorded, in accordance with subsection (d)(3), and the most hazardous condition so found shall govern procedures to be followed.

(5) If dangerous air contamination and/or oxygen deficiency does not exist within the space, as demonstrated by tests performed in accordance with subsection (d)(3), entry into and work within the space may proceed subject to the following provisions:

(A) Testing, in accordance with subsection (d)(3), shall be conducted with sufficient frequency to ensure that the development of dangerous air contamination and/or oxygen deficiency does not occur during the performance of any operation.

(B) If the development of dangerous air contamination and/or an oxygen deficiency is imminent, the requirements prescribed by subsection (e) shall also apply.

(6) Where the existence of dangerous air contamination and/or oxygen deficiency is demonstrated by tests performed in accordance with subsection (d)(3), existing ventilation shall be augmented by appropriate means.

(7) When additional ventilation provided in accordance with subsection (d)(6) has removed dangerous air contamination and/or oxygen deficiency as demonstrated by additional testing conducted (and recorded) in accordance with subsection (d)(3), entry into and work within the space may proceed subject to the provisions of subsection (d)(5).

(8) No source of ignition shall be introduced until the implementation of appropriate provisions of this section have ensured that dangerous air contamination due to flammable and/or explosive substances does not exist.

(9) Whenever oxygen-consuming equipment such as salamanders, plumbers' torches or furnaces, and the like, are to be used, measures shall be taken to ensure adequate combustion air and exhaust gas venting.

(10) To the extent feasible, provision shall be made to permit ready entry and exit.

(11) Where it is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems employing harmful design concentrations of toxic or oxygen-displacing gases, or total foam flooding, such systems shall be deactivated. Where it is not practical or safe to deactivate such systems, the provisions of subsection (e) related to the use of respiratory protective equipment shall apply during entry into and work within such spaces.

(e) Confined Space Operations.

(1) Entry Into and Work Within Confined Spaces. The requirements of this subsection apply to entry into and work within a confined space: whenever an atmosphere free of dangerous air contamination and/or oxygen deficiency cannot be ensured through the implementation of the applicable provisions of subsection (d), or whenever, due to the existence of an emergency, it is not feasible to ensure the removal of dangerous air contamination and/or an oxygen deficiency through the implementation of the applicable provisions of subsection (d).

(A) Tanks, vessels, or other confined spaces with side and top openings shall be entered from side openings when practicable.

NOTE: For the purposes of this Order, side openings are those within $3^1/_2$ feet of the bottom.

(B) Appropriate, approved respiratory protective equipment, in accordance with Section 5144, shall be provided and worn.

(C) An approved safety belt with an attached line shall be used. The free end of the line shall be secured outside the entry opening. The line shall be at least $^1/_2$-inch diameter and 2,000-pounds test.

EXCEPTION: Where it can be shown that a safety belt and attached line would further endanger the life of the employee.

(D) At least one employee shall stand by on the outside of the confined space ready to give assistance in case of emergency. At least one additional employee who may have other duties shall be within sight or call of the standby employee(s).

1. The standby employee shall have appropriate, approved, respiratory protective equipment, including an independent source of breathing air which conforms with Section 5144(e), available for immediate use.

2. A standby employee (or employees) protected as prescribed by subsection (e)(1)(D)1. may enter the confined space but only in case of emergency and only after alerting at least one additional employee outside of the confined space of the existence of an emergency and of the standby employee's intent to enter the confined space.

(E) When entry must be made through a top opening, the following requirements shall also apply.

1. The safety belt shall be of the harness type that suspends a person in an upright position.

2. A hoisting device or other effective means shall be provided for lifting employees out of the space.

(F) Work involving the use of flame, arc, spark, or other source of ignition is prohibited within a confined space (or any adjacent space having common walls, floor, or ceiling with the confined space) which contains, or is likely to develop, dangerous air contamination due to flammable and/explosive substances.

(G) Whenever gases such as nitrogen are used to provide an inert atmosphere for preventing the ignition of flammable gases or vapors, no flame, arc, spark, or other source of ignition shall be permitted unless the oxygen concentration is maintained at less than 20 percent of the concentration which will support combustion.

1. Testing of the oxygen content shall be conducted with sufficient frequency to ensure conformance with this paragraph.

2. A written record of the results of such testing shall be made and kept at the work site for the duration of the work.

3. Affected employees and/or their representative shall be provided an opportunity to review and record the testing results.

(H) Only approved lighting and electrical equipment, in accordance with the Low-Voltage Electrical Safety Orders, shall be used in confined spaces subject to dangerous air contamination by flammable and/or explosive substances.

(I) Employees working in confined spaces which have last contained substances corrosive to the skin or substances which can be absorbed through the skin shall be provided with, and shall be required to wear, appropriate personal protective clothing or devices in accordance with Article 10.

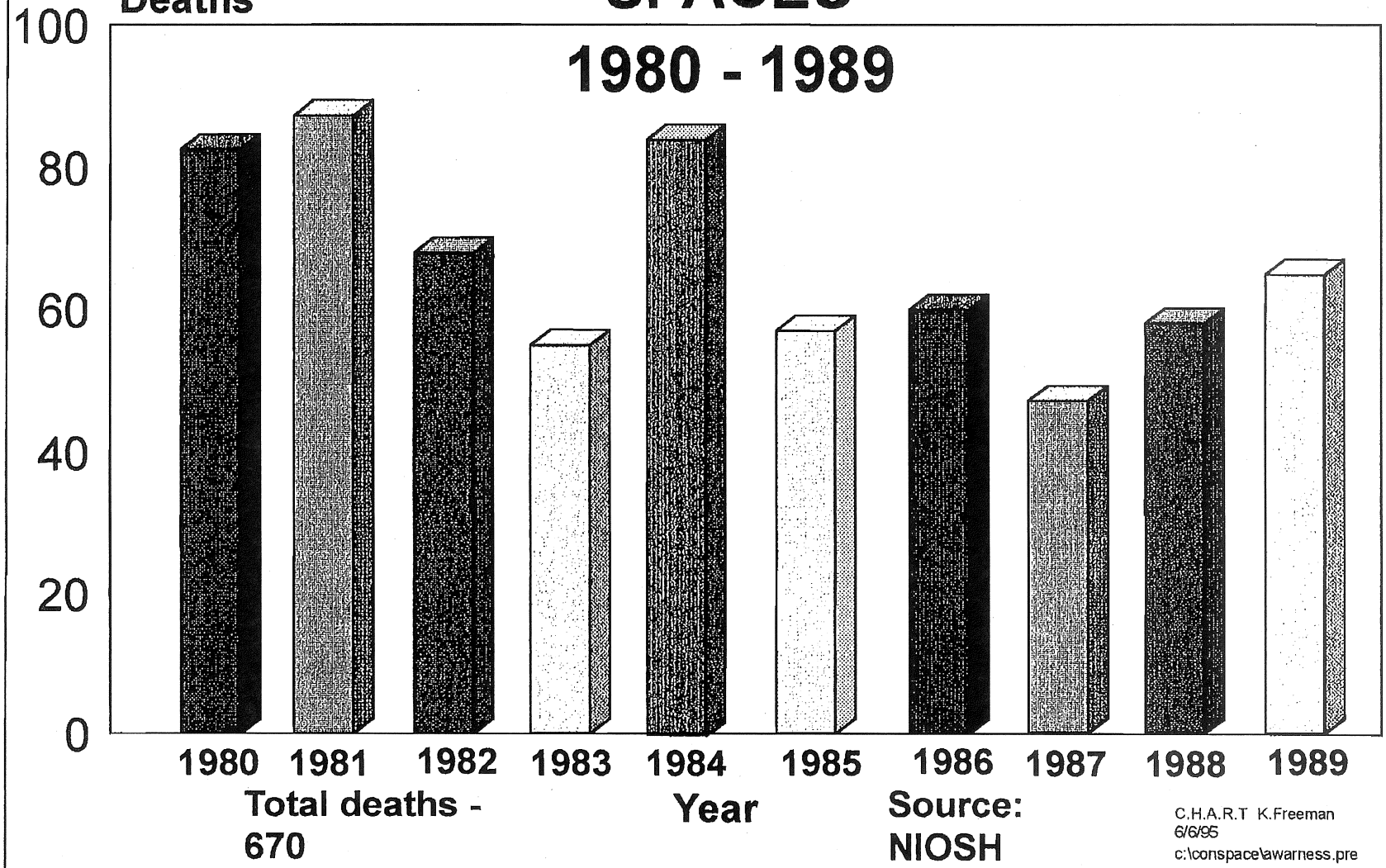
(2) Precautions for Emergencies Involving Work in Confined Spaces.

(A) At least one person trained in first aid and cardiopulmonary resuscitation (CPR) shall be immediately available whenever the use of respiratory protective equipment is required subsection (e)(1). Standards for CPR training shall follow the principles of the American Heart Association or the American Red Cross.

(B) An effective means of communication between employees inside a confined space and a standby employee shall be provided and used whenever the provisions of subsection (e)(1) require the use of respiratory protective equipment or whenever employees inside a confined space are out of sight of the standby employee(s). All affected employees shall be trained in the use of such communication system and the system shall be tested before each use to confirm its effective operation.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

DEATHS IN CONFINED SPACES



CAUSES OF FATALITIES IN CONFINED SPACES

65 % Hazardous atmospheres (oxygen deficient, toxic combustible

13% Engulfment (burial/submersion into particulate or fluids)

7% Struck by falling objects

6% Heat stress/exposure

4% All others

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CONFINED SPACE

1. Area large enough to enter to work; and

2. Has limited or restricted means for entry exit, and

3. Is not designed for continuous employee occupancy

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PERMIT REQUIRED CONFINED SPACE

(Meets the definition of a confined space and contains one or more of the following:)

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

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TOPIC: **Atmospheric Hazards and Air Monitors**

TIME FRAME: 1:00

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- identify what constitutes a hazardous atmosphere
- define the basic rules of air monitoring testing for confined spaces
- identify the target gases to be concerned with in confined space operations

Standard: With a minimum of 80% accuracy according to the Information Sheet 1-1, Pages 3 through 13 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Overhead projector and screen
- Overhead transparencies for this lesson plan
- Written quiz

REFERENCES:

- Information Sheet 1-1, Pages 3 through 13
- Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: Confined spaces contain many hazards, one of these is the potential for a hazardous atmosphere. In fact hazardous atmospheres account for nearly 65% of all fatalities that occur in confined spaces. It is imperative that we understand how to determine when a confined space contains a hazardous atmosphere. We must understand the process to follow to determine the hazardous atmosphere is present as well as what some of the target gases are and their characteristics.

PRESENTATION	APPLICATION

I. EFFECTS OF HAZARDOUS ATMOSPHERES

A. Suffocation

NOTE: 65% of fatalities occurring in confined spaces are a result of hazardous atmospheres.

B. Poisoning

C. Explosion/fire

II. HAZARDOUS ATMOSPHERE

A. An atmosphere which exposes employees to a risk of death, incapacitation, injury or acute illness from one or more of the following causes

1. O_2 level below 19.5% or above 23.5%
2. Flammable gas or vapor in excess of 10% of L.E.L.
3. Airborne combustible dust at a concentration that obscures vision at 5 feet or less
4. Any immediately dangerous to life or health (IDLH) atmosphere

III. TARGET GASES AND EFFECTS

OHT 2-1

A. Oxygen

1. Must be between 19.5% and 23.5% by volume for atmosphere to be considered safe
2. Above 23.5% by volume the environment becomes unstable and prone to flash fires or explosion

PRESENTATION	APPLICATION
3. Below 16% physical effects will become apparent	
B. Methane	
1. Colorless	
2. Odorless	
3. Non-toxic	
4. Asphyxiant (displaces O_2)	
5. Lighter than air	
6. Explosive range (5% to 15%)	
OHT 2-2	
C. Carbon Monoxide	
1. Colorless	
2. Odorless	
3. Toxic	
4. Asphyxiant (displaces O_2)	
5. Vapor density = to air	
6. Explosive range (12.5% to 74.2%)	
OHT 2-3	
D. Hydrogen Sulfide	
1. Colorless	
2. Smell like rotten eggs	

PRESENTATION	APPLICATION
3. Toxic	
4. Vapor density is 1.19	
5. Explosive range (4% to 44%)	
6. Common in sewage facilities	
7. Diminishes your sensitivity to smell	
NOTE: The rapid negative impact to the entrants olfactory (sense of smell) system makes many people believe this gas is no longer present when it is still at deadly levels	
E. Sulfur dioxide	
1. Pungent	
2. Irritating gas	
3. 1-10 ppm exposure causes respiratory and pulse rate increase and decrease in depth of respiration	
4. Vapor density is 2.26	
5. Non-flammable	
F. Carbon dioxide	
1. Colorless	
2. Odorless	
3. Non-combustible gas	
4. Toxic	
5. Exposure symptoms	

PRESENTATION	APPLICATION
a) Headache b) Dizziness c) Restlessness 6. Vapor density is 1.53 NOTE: Relying heavily on a suspected gas to be "lighter" or "heavier" than air to determine its' location in a space can be a fatal mistake. Gas concentrations high enough to be toxic can float along with the rest of the air molecules, they neither sink nor rise.	
	How can we be sure that hazardous concentrations of these gases are not in the confined spaces that we have to enter to perform rescue?
IV. ATMOSPHERIC MONITORS A. Types of air monitors/alarms 1. Single gas monitors a) Will monitor only one preset gas 2. Multiple gas monitors a) Will monitor multiple preset gases	

PRESENTATION	APPLICATION
1) Monitors that sense four(4) gases at once are commonly used in confined space operations referred to as four(4) in one(1) monitors	
B. Monitoring operations	
1. Monitoring should be done in the following order every time	
a) Oxygen content (first)	
b) Flammable gases/vapors (second)	
c) Potential toxic contaminants (third)	
2. Testing should be done prior to lifting person hole covers	
a) To get the most accurate reading	
b) To eliminate potential explosions	
3. Testing should be done at all levels of the confined space	
a) Stratification of gases may occur due to vapor density of gases vary	
4. Testing must continue periodically	
5. Results of monitoring must be logged	
a) On entry permit as well as data log of monitor if equipped	

SUMMARY:

Atmospheric conditions are the number one killer in confined space incidents. Only by confirming what the atmospheric contents of the space is, can we enter the space with the appropriate protection in place. To do this we use atmospheric monitors by sensing first for O_2, then flammable gases and vapors, and then potential toxic air contaminants. It is imperative that we have a knowledge of target gases found in confined spaces and the effects they may have on our rescuers (entrants). In addition we must continue to monitor throughout our operation so that we can eliminate the potential for death or injury due to changing atmospheric conditions as can occur in sewer operations.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

EFFECTS OF VARIOUS O_2 LEVELS

% OXYGEN	PHYSIOLOGICAL EFFECTS
19.5 - 16	No visible effect
16 - 12	Increased breathing rate. Accelerated heartbeat. Impaired attention, thinking and coordination.
14-10	Faulty judgment and poor muscular coordination. Muscular exertion causing rapid fatigue. Intermittent respiration.
10 - 6	Nausea, vomiting. Inability to perform vigorous movement, or loss of the ability to move. Unconsciousness, followed by death.
Below 6	Difficulty breathing. Convulsive movements. Death in minutes.

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EFFECTS OF VARIOUS CO LEVELS

PPM Level (CO)	PHYSIOLOGICAL EFFECTS
100 ppm for 3 hours or 600 ppm for 1 hour	Headache and discomfort
500 ppm for 1 hour or 1000 ppm for 30 minutes	Pounding of heart, dull headache, dizziness, flashes before eyes, ringing in ears, nausea.
1500 ppm for 1 hour	Dangerous to life
4000 ppm	Rapid collapse, unconsciousness and death within a few minutes.

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EFFECTS OF VARIOUS H_2S LEVELS

PPM (H_2S)	PHYSIOLOGICAL EFFECTS
15 - 25 ppm	Eye irritation
50 - 150 ppm for several hours	Slight eye, respiratory irritation
170 - 300 ppm for 1 hour	Marked irritation
400 - 600 ppm for 1/2 - 1 hour	Unconsciousness, death
1000 ppm	Fatal in minutes

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TOPIC: **Physical and Engulfment Hazards**

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- recognize what constitutes a physical or engulfment hazard
- identify target industries that routinely have physical or engulfment hazards

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Pages 14 & 15 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Overhead projector and screen
- Overhead transparencies for this lesson plan
- Written quiz

REFERENCES:

- Information Sheet 1-1, Pages 14 & 15
- Title 8, California Code of Regulations(CCR), General Industry Safety Orders(GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: NIOSH reports that for the period 1980 through 1989 that 227 lives were lost in confined spaces as a result of engulfment. 124 deaths were caused by grain, the remainder were fertilizer, cement, gravel, sawdust, etc. Regardless of the material, most of these victims miscalculated the stability of the material they were walking on. In addition many others lost their lives due to equipment in the spaces. This equipment either caused them to fall or they became caught or disfigured in or by the equipment. Only through identifying the hazards early, and using appropriate safety equipment can we reduce our chances of becoming one of these statistics.

PRESENTATION	APPLICATION
I. PHYSICAL HAZARDS	
A. Grinding equipment	
B. Agitators	
C. Mulching equipment	
D. Drive shafts	
E. Gears and other moving equipment	
F. Steam or steam fittings	
G. Electrocution	
H. Falling objects	
II. ENGULFMENT HAZARDS	
OHT 3-1	
	What materials do you think provide a potential of engulfing an entrant?
A. Materials involved in engulfment incidents	
1. Grains	
2. Sand	
3. Gravel	

PRESENTATION	APPLICATION
4. Cement	
5. Clay	
6. Sawdust	
7. Liquids	
B. Causes of engulfment incidents	
1. Walking on unstable material that has void spaces below	
a) Bridging	
2. Improper or lack of use of safety/retrieval lines	
3. Overhead flow of particulate matter or liquids activated inadvertently	
III. TARGET INDUSTRIES	
A. Physical and engulfment hazards	
1. Industry with mechanized assembly equipment	
2. Spaces with electrical, hydraulic or pneumatic equipment supplied to it, or within it	
3. Grain or particulate matter production or processing	
4. Industries that have spaces with top load applications	
5. Industries that have spaces with bottom dump applications	

SUMMARY:

Physical and engulfment hazards are the number two(2) killers of personnel in confined spaces. If for no other reason than this, these hazards demand our utmost attention. Unfortunately, though confined spaces make it difficult to identify hazards and secure them. By their very nature, confined spaces concentrate hazards, making it difficult to separate the worker from the hazard. Facilities relying on outside rescue services (i.e., the fire department) are required by CAL-OSHA to provide access and opportunity for rescue pre-planning. It is to our advantage to capitalize on the opportunity so that we can fully understand our potential rescue problem. By pre-planning what industries are in our jurisdiction and researching the hazards we can reduce our risk and work safely in a potentially dangerous environment.

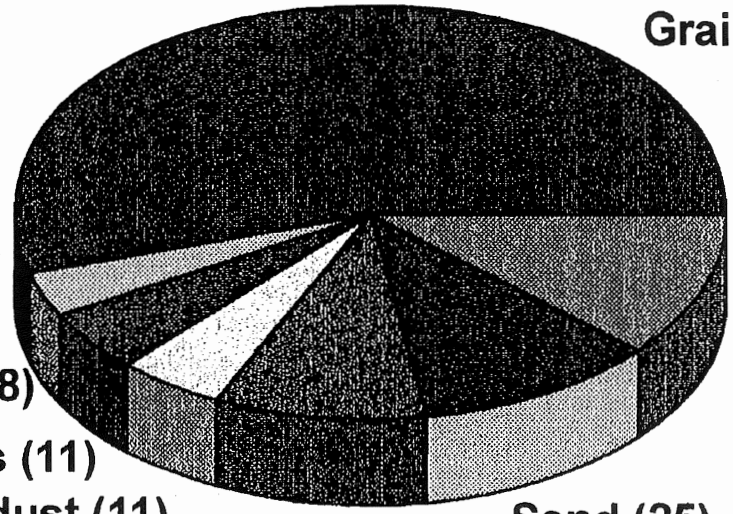
EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

LOOSE MATERIALS INVOLVED IN MECHANICAL ASPHYXIATIONS 1980 - 1989



Total deaths - 227

Source: NIOSH

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INSTRUCTOR GUIDE

TOPIC: **Lock-Out/Tag-Out Procedures and Entry Permits**

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- recognize the need for lock-out/tag-out procedures
- define techniques of lock-out/tag-out
- identify the components of an entry permit
- identify operations that are permit exempted

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Pages 15 through 18 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Overhead projector and screen
- Overhead transparencies for this lesson plan
- Written quiz
- Information Sheet 4-1

REFERENCES:

- Information Sheet 1-1, Pages 15 through 18
- Title 8, California Code of Regulations(CCR), General Industry Safety Orders(GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: Inside any given confined space there can be numerous life threatening hazards that are present. Many of these hazards are a result of potential energy sources that can power equipment or move product in a way that can catch the entrant off guard and injure or kill them. To eliminate this potential we have developed procedures and equipment to "lock-out" any potential energy source and to "tag-out" the equipment so that all other parties will be aware of the shutdown.

A confined space rescue incident requires the consideration of many things, and the documentation of a lot of information. To reduce the chances of any considerations being overlooked or information not documented, a formal "Entry Permit" has been established.

This document is used much like a tactical worksheet, CAL-OSHA provides an example of one in Title 8, Appendix D-2, Section 5157. Each jurisdiction can develop an entry permit that best suits their need, but it must include the components set forth by CAL-OSHA.

PRESENTATION	APPLICATION
I. LOCK-OUT/TAG-OUT PROCEDURES	
A. Procedures performed to isolate any potential energy source to the space	
1. Electricity	
2. Hydraulic	
3. Steam	
4. Drive mechanisms	
5. Pneumatic	
6. Gravity flow of product	
B. Must be performed by an authorized employee	
	How do other workers/rescuers know that the energy source should remain locked-out?
C. Printed tags and locks are used to warn other employees of isolated energy source	
OHT 4-1	
NOTE: Distribute Information Sheet 4-1	
D. Examples of lock-out/tag-out	
1. Electrical switches locked-out	
2. Hydraulic lines blocked and bled	
3. Steam line blind flanged	
4. Drive mechanisms disconnected	

PRESENTATION	APPLICATION

5. Drive belts removed

6. Liquid valves locked-out

7. Overhead dumps locked-out

II. ENTRY PERMITS

A. A form or tactical worksheet required by CAL-OSHA that must be completed for confined space entries

B. Components of an entry permit

1. Location of the confined space

2. Purpose of the entry

3. Date of entry and authorized duration

4. List of authorized entrants

5. List of attendants

6. Entry supervisor signature

7. List of necessary tools and equipment

8. List of special hazards

9. Results of initial and periodic atmosphere tests

10. Measures to isolate the space and control hazards prior to entry

    a) Lock-out/tag-out

11. Listing of rescue and emergency services

12. Communications procedures

13. Additional

PRESENTATION	APPLICATION
OHT 4-2	
C. Prior to entry the entry supervisor must	
1. Approve the permit	
D. Upon completion of entry	
1. Permit must be signed and cancelled by the entry supervisor	
2. Permit must be filed and retained at least one(1) year	
NOTE: The entry permit is an excellent resource for responding rescuers.	
III. OSHA EXEMPTIONS TO PERMIT REQUIRED REGULATIONS	
	What operations are not within the scope of permit required regulations but are covered by 5158 CCR, OTHER CONFINED SPACE OPERATIONS?
A. Exemptions granted due to regulation by other sections of the California Code of Regulations(CCR) or CFR	
1. Selected construction operations	
a) Defined by Section 1502	
2. Selected agriculture operations	
a) Defined by Section 3437	
3. Marine terminal operations	

PRESENTATION	APPLICATION
a) Defined in Section 3460	
4. Shipyard operations	
a) Regulated by Section 8437	
5. Telecommunications people holes and vaults	
a) Regulated by Section 8616	
6. Grain handling facilities	
a) Defined by Section 5178	
7. Electric utility operations within underground vaults	
NOTE: These exemptions may be more lenient or as strict as Sections 5156, 5157 and 5158.	
B. Exemptions based on employer proof of atmospheric hazard only	
1. Must not contain any other hazards except atmospheric condition only	
2. Hazard can be eliminated by ventilation alone	
C. When exemptions are granted components of the normal entry program may or may not be present	
1. Entry permit may not be provided	
2. Attendant my not be present	
3. Entrant lowering and retrieval equipment may not be present	
D. Exemptions are only valid when entry is for the prescribed purpose	

PRESENTATION	APPLICATION
1. To evacuate an injured worker out of an exempted space would nullify the exemption, and Sections 5156, 5157 and 5158 would prevail	

SUMMARY:

Lock-out and Tag-out procedures are those procedures that are performed to isolate any potential energy source and to mark its' deactivation so that other workers cannot turn the source back on. These procedures are essential to a confined space incident so that entrants will not be injured or killed by material or equipment in the space.

Entry permits are a formal written document that lists those requirements that must be completed and documented to make a safe and legal entry. This document is used much like a tactical worksheet and must be completed at all permit required space entries unless the operation meets the criteria of one of the many OSHA exemptions. In this case certain parts of the required components may not be required.

It is imperative that we complete an entry permit when performing rescues, and that we request the entry permit that was completed at the site prior to our arrival to use as a reference for understanding the current situation.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

CONFINED SPACE
RESCUE ENTRY PERMIT

This permit shall be completed and remain at the rescue site for the duration of the rescue operation.

Location of confined space: _____

Description of confined space: _____

Date and time started: _____ Date and time completed: _____

Entry Supervisor: _____ Attendant: _____

Authorized Entrant: _____ Back-up Entrant: _____

Authorized Entrant: _____ Back-up Entrant: _____

Facility contact person: _____ Safety Officer: _____

"Qualified Person"

Use of confined space: _____

Special Potential Hazards: _____

Atmospheric Monitoring Results							
DATE	TIME	% OXYGEN	% LEL	(p.p.m.) H2S	(p.p.m.) CO	OTHER (p.p.m.)	INITIAL

PRE-ENTRY CHECKLIST

- ☐ Operations Perimeter set-up
- ☐ Confirm Lock-out/Tag-out
- ☐ Eliminate Ignition Source
- ☐ Provide Lighting
- ☐ Other: _____
- ☐ Protective Clothing
- ☐ Respiratory Protection
- ☐ Atmospheric Monitoring
- ☐ Ventilation
- ☐ Communications

Entrant	Entry Time	SCBA Pressure	SAR Pressure	Exit Time

RESCUE ENTRY PERMIT
(continued)

COMMUNICATION PLAN

- ☐ Visual/Hand Signals
- ☐ Voice
- ☐ Radio (Intrinsically Safe)
- ☐ Rope Signals

VENTILATION PLAN

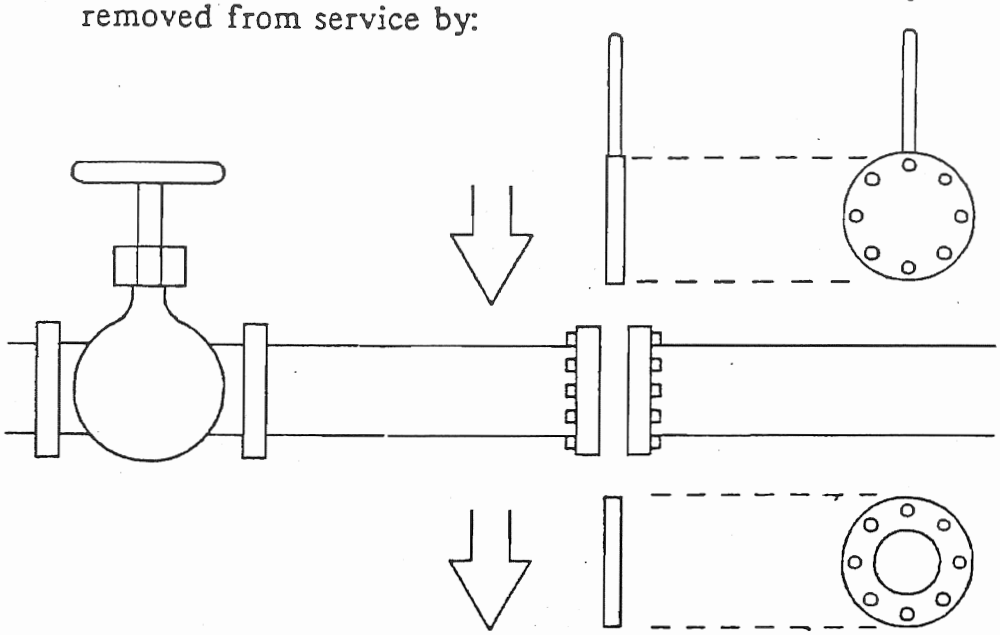
- ☐ Natural
- ☐ Forced Exhaust
- ☐ Forced Supply
- ☐ Forced Supply & Exhaust

Gas	Physical Characteristics	Flammability LEL	Toxicity TLV
Carbon monoxide CO	Colorless Odorless	12.5%	.0025% [25 ppm]
Carbon dioxide CO_2	Colorless Odorless	Non-flammable	.5% [5000 ppm]
Methane CH_4	Colorless Odorless	5%	Non-toxic
Hydrogen sulfide H_2S	Colorless Rotten egg odor	4%	.001% [10 ppm]
Sulfur dioxide SO_2	Colorless Suffocating odor	Non-flammable	.0002% [2 ppm]
Nitrogen dioxide NO_2	Brown Pungent odor	Non-flammable	.0003% [3 ppm]

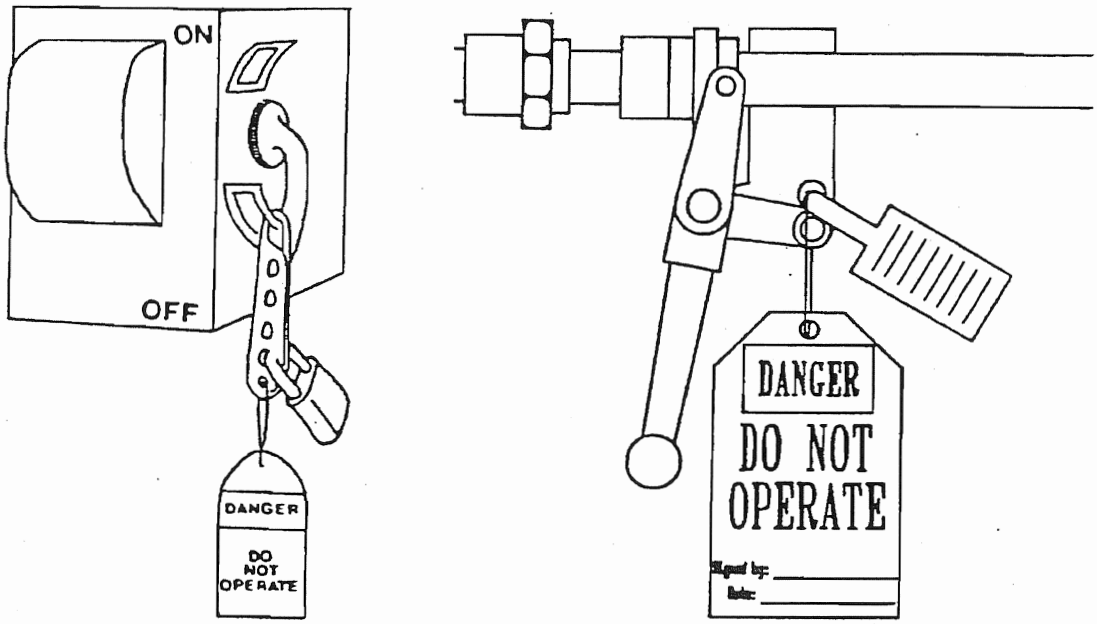
► NOTES ◄	
Entry Group Supervisor's Signature	Date:

ISOLATION

Isolation of a confined space is a process where the space is removed from service by:



Method of Blanking Hydraulic/Pneumatic Lines



Examples of Lockout

CONFINED SPACE
RESCUE ENTRY PERMIT

This permit shall be completed and remain at the rescue site for the duration of the rescue operation.

Location of confined space: _____

Description of confined space: _____

Date and time started: _____ Date and time completed: _____

Entry Supervisor: _____ Attendant: _____

Authorized Entrant: _____ Back-up Entrant: _____

Authorized Entrant: _____ Back-up Entrant: _____

Facility contact person: _____ Safety Officer: _____

"Qualified Person"

Use of confined space: _____

_____

Special Potential Hazards: _____

_____

Atmospheric Monitoring Results							
DATE	TIME	% OXYGEN	% LEL	(p.p.m.) H2S	(p.p.m.) CO	OTHER (p.p.m.)	INITIAL

PRE-ENTRY CHECKLIST

- ☐ Operations Perimeter set-up
- ☐ Confirm Lock-out/Tag-out
- ☐ Eliminate Ignition Source
- ☐ Provide Lighting
- ☐ Other: _____
- ☐ Protective Clothing
- ☐ Respiratory Protection
- ☐ Atmospheric Monitoring
- ☐ Ventilation
- ☐ Communications

Entrant	Entry Time	SCBA Pressure	SAR Pressure	Exit Time

RESCUE ENTRY PERMIT
(continued)

COMMUNICATION PLAN

- ☐ Visual/Hand Signals
- ☐ Voice
- ☐ Radio (Intrinsically Safe)
- ☐ Rope Signals

VENTILATION PLAN

- ☐ Natural
- ☐ Forced Exhaust
- ☐ Forced Supply
- ☐ Forced Supply & Exhaust

Gas	Physical Characteristics	Flammability LEL	Toxicity TLV
Carbon monoxide CO	Colorless Odorless	12.5%	.0025% [25 ppm]
Carbon dioxide CO_2	Colorless Odorless	Non-flammable	.5% [5000 ppm]
Methane CH_4	Colorless Odorless	5%	Non-toxic
Hydrogen sulfide H_2S	Colorless Rotten egg odor	4%	.001% [10 ppm]
Sulfur dioxide SO_2	Colorless Suffocating odor	Non-flammable	.0002% [2 ppm]
Nitrogen dioxide NO_2	Brown Pungent odor	Non-flammable	.0003% [3 ppm]

▸ NOTES ◂	
Entry Group Supervisor's Signature	Date:

TOPIC: **Ventilation Equipment and Techniques**

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- identify the three principal ventilation plans
- recognize considerations that will impact the ventilation operation

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Page 16 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Overhead projector and screen
- Overhead transparencies for this lesson plan
- Written quiz

REFERENCES:

- Information Sheet 1-1, Page 16
- Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: Ventilation operations should be performed whether or not respiratory protection is in use when entering a confined space. Ventilation procedures will limit the chances of toxic or explosive atmospheres from developing. Certain specialized equipment will make the operation more effective and easier. Numerous conditions and circumstances will impact the ventilation operation, these conditions must be considered when developing your ventilation plan.

PRESENTATION	APPLICATION
I. VENTILATION EQUIPMENT	
	What equipment do we use to get fresh air into the confined space?
A. Industrial fans/ventilators	
B. Smoke ejector fans	
C. Duct work	
D. Person hole saddle vents	
II. VENTILATION PLANS	
A. Ventilation plans are predominantly carried out in one of three ways	
1. Forced supply ventilation	
2. Force exhaust ventilation	
3. Force supply and exhaust ventilation	
OHT 5-1 and 5-2	
III. VENTILATION PLAN CONSIDERATIONS	
A. Configuration of the space	
B. Number of openings in the space	
C. Location of the openings	
1. Vertical (top)	
2. Horizontal (side)	
3. Bottom	

PRESENTATION	APPLICATION
D. Vapor density of suspected vapors	
E. Wind direction	
F. Equipment available	
IV. VENTILATION PLAN HAZARDS	
	What are some potential hazards that can develop while performing ventilation procedures?
A. Directing exhausted explosive vapors toward ignition sources	
B. Directing vehicle exhaust (or other hazardous vapors) into the supply fans	
C. Changing a non-explosive atmosphere into an explosive atmosphere	
1. Diluting an atmosphere that is above its UEL down below its explosive range would require passing through the explosive range	

SUMMARY:

Ventilation operations are a critical component of the overall confined space rescue procedure. CAL-OSHA, Title 8 addresses ventilation in Section 5157 (c), "General Requirements". This section basically states that forced air ventilation will be initiated prior to entry and that it shall continue until all entrants have left the space.

Your ventilation operation will generally fall into one of three categories, 1) forced supply, 2) forced exhaust, 3) forced supply and exhaust. Many factors will impact which operation you may choose or the particular technique.

Specialized equipment has been developed to make the task of ventilation easier and more effective, although basic equipment will suffice when specialized equipment is not available. Regardless of the circumstances or equipment available, ventilation operations must be completed to reduce the chances of a buildup of toxic or explosive gases.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

FIGURE 2 POSITIVE PRESSURE

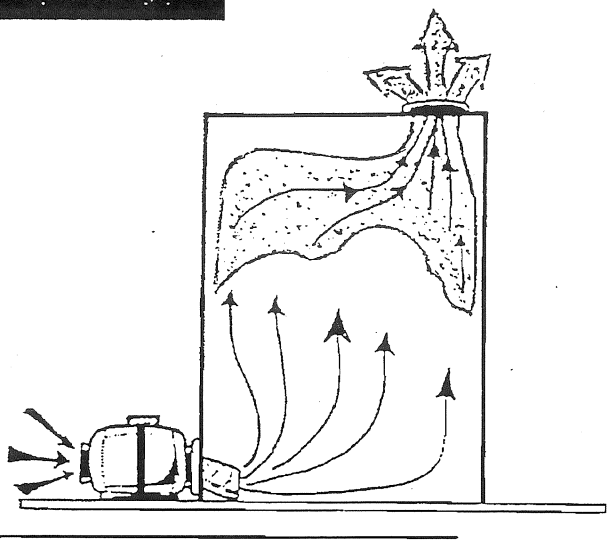


FIGURE 3 NEGATIVE PRESSURE

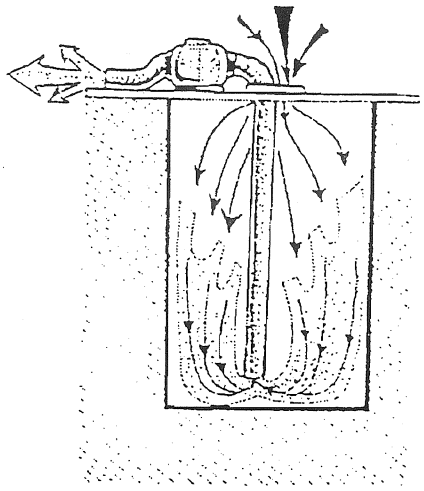


FIGURE 4 POSITIVE/NEGATIVE PUSH/PULL

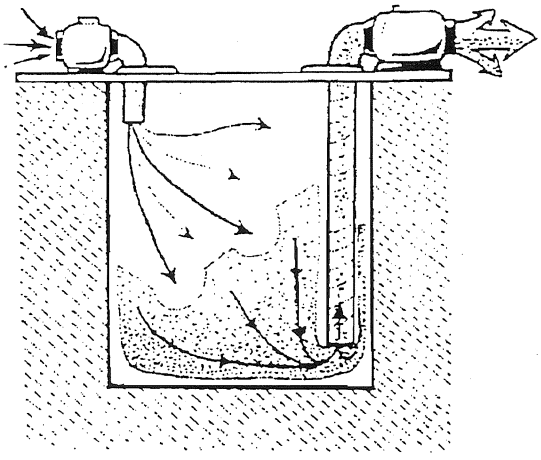


FIGURE 5 SHORT–CIRCUITING

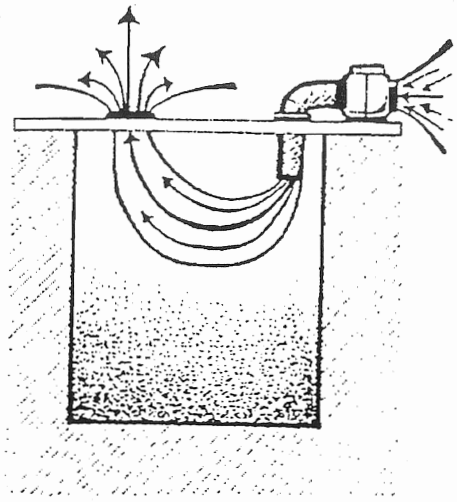
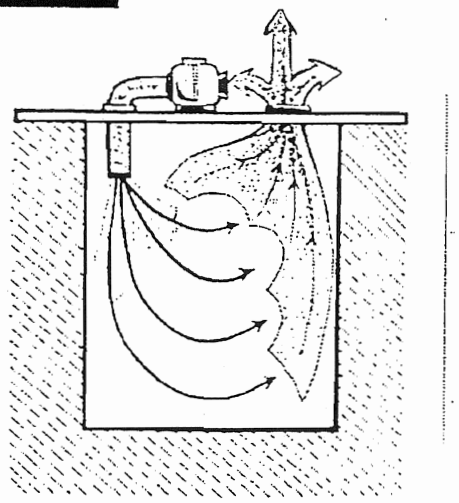


FIGURE 6 RECIRCULATING



TOPIC: **Respiratory Equipment and Techniques**

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- recognize the need for respiratory protection in confined space operations
- identify the different types of respiratory protection suitable for confined space operations

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Pages 19 through 21 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Written quiz

REFERENCES:

- Information Sheet 1-1, Pages 19 through 21
- Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: Once the atmosphere has been tested proper respiratory protection must be selected. There are many different types of respiratory protection systems available, your choice will be impacted by your needs and the features of the given equipment. When performing confined space rescue operations you need to have respiratory equipment ready for immediate use regardless of the present condition as the atmospheric conditions can be unpredictable.

PRESENTATION	APPLICATION

I. RESPIRATORY PROTECTION REQUIREMENTS

A. Respiratory protection must be provided and personnel trained if the following conditions exist

1. Testing demonstrates the existence of dangerous or deficient conditions and additional ventilation cannot reduce concentrations to safe levels

2. The atmosphere tests as safe but unsafe conditions can reasonably be expected to develop

3. It is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems and it is not practical or safe to deactivate such systems

4. An emergency exists and it is not feasible to wait for pre-entry procedures to take effect.

II. RESPIRATORY PROTECTION CLASSIFICATIONS

A. Self-contained breathing apparatus

1. Considered highest level of protection

2. Supply is carried with entrant

3. No air hoses to outside to restrict movement

4. Cylinder size can cause difficulty in tight spaces

B. Combination/dual purpose SCBA

1. Same as simple SCBA with addition of high press inlet hose

C. Supplied air respirator with escape cylinder

PRESENTATION	APPLICATION
1. Air is supplied to entrants mask from outside the space	
2. Capable of endless air supply	
3. Must include escape cylinder	
a) Normally five(5) to ten(10) minute duration	
4. Air line not to exceed 300' from source	
D. Air purifying respirators	
1. Must not be oxygen deficient atmosphere	
2. Cartridge must be specific to vapor, mist, fumes, dusts, etc	
3. Not recommended unless conditions are known and can be maintained	

SUMMARY:

Appropriate respiratory protection at a confined space rescue incident will eliminate the possibility of entrants falling prey to the #1 killer in confined spaces, atmospheric conditions. According to CAL-OSHA regulations respiratory protection is not required in all situations, including some rescues. Regardless of the regulations it is widely accepted that rescuers should enter with full respiratory protection due to the uncertainty of conditions coupled with the potential for a stratification of gases. Respiratory protection systems include the normal self-contained breathing apparatus, combination/dual purpose SCBA, supplied air respirators with escape cylinder and air purifying respirators. All of these types have certain applications although air purifying respirators are not recommended. Training and familiarity of the equipment is imperative for personnel using this equipment in confined space operations.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

TOPIC: **Communications Equipment and Techniques**

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- define the requirements for communications system
- identify the different types of acceptable communications systems

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Page 22 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Written quiz

REFERENCES:

- Information Sheet 1-1, Page 22
- Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: It is imperative that confined space entrants be able to communicate with the attendants. Only through a communication system can both parties be aware of problems that may require evacuation of the space. CAL-OSHA understands the importance of communication during confined space operations, and enforces regulations requiring a communication plan to be in place. There are a number of different communication plans/techniques that comply with the regulations, the environment and cost are two main considerations when deciding upon equipment.

PRESENTATION	APPLICATION

I. COMMUNICATIONS EQUIPMENT

A. Battery operated portable radios

1. Push to talk operations
2. Voice activated operations
3. Ear mike option
4. Two way - multiple users
5. Reception/transmission interference
6. Electronic equipment must be intrinsically safe

NOTE: Portable radios can cause interference with unshielded monitoring equipment

B. Hard wire systems

1. Push to talk operation
2. Voice activated operations
3. Ear mike option
4. Conference operation - multiple users
5. Hard wire can restrict movement
6. Electronic equipment must be intrinsically safe

C. Hand signals

1. Basic signals
2. Must be committed to memory
3. Must have visual contact

PRESENTATION	APPLICATION

D. Rope signals

1. Basic signals

2. Must be committed to memory

3. Restricts movement

E. Tapping or rapping codes on tanks

1. Basic codes

2. Must be committed to memory

3. Limited application

NOTE: It is recommended that each entrant wear a personal distress device (PDD) as well as the communication system.

II. CAL-OSHA REGULATIONS

A. Permit required confined spaces (normal operations)

1. Communication equipment and procedures to maintain contact between entrants and attendants must be provided

B. Permit required confined spaces with any of the following conditions

1. Testing demonstrates the existence of dangerous or deficient conditions and additional ventilation cannot reduce concentrations to safe levels

2. The atmosphere tests as safe but unsafe conditions can reasonably be expected to develop

PRESENTATION	APPLICATION
3. It is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems and it is not practical or safe to deactivate such systems	
4. An emergency exists and it is not feasible to wait for pre-entry procedures to take effect	
a) Continuous powered communications equipment shall be maintained between the worker within the confined space and standby personnel in the above listed situations	

SUMMARY:

A communication plan is required in permit required confined space entries. There are numerous types of equipment available including portable radios, hard wire systems, hand signals, rope signals, etc. The choice of what type of equipment/plan is left up to the employer, except in more critical situations where regulations require continuous powered equipment. Regardless of what type of equipment is used, the over riding factor is to provide a reliable communications link between the entrant and the attendant.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

INSTRUCTOR GUIDE

TOPIC: **Entrant Retrieval Equipment**

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- recognize regulations governing entrant retrieval equipment and operations
- identify the equipment needed to successfully complete entry and retrieval operations

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Page 23 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Overhead projector and screen
- Overhead transparencies for this lesson plan
- Written quiz

REFERENCES:

- Information Sheet 1-1, Page 23
- Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: NIOSH and OSHA studies reveal that as many as 60% of the deaths that occur in confined spaces happen to would be rescuers. Proper use of lowering and retrieval equipment allows for the possibility of non-entry rescue procedures, thus no one in addition to the original entrant is placed in jeopardy. The equipment used to provide this protection can be complex and expensive or fashioned from life-safety rope and basic rope system hardware. Regardless of the system you choose to use, you will need to understand the requirements of the code and practice with the equipment.

PRESENTATION	APPLICATION

I. OSHA REQUIREMENTS FOR RETRIEVAL EQUIPMENT

A. OSHA requires retrieval line and fall restraint when vertical entry of five feet or more below grade is made

B. Retrieval lines must be attached to a mechanical device (mechanical advantage) outside the space

C. Entrants are to stay "on line" unless this would increase entrant risk of injury, or is impossible

1. Staying on line allows for non-entry rescue

OHT 8-1

II. LIFTING, LOWERING AND FALL RESTRAINT EQUIPMENT

A. Anchoring devices (high point anchor)

1. Tripod

a) Manufactured

b) Fabricated

1) Ladders

2) Timber

2. Ladder gin

3. Davit mounted systems

4. Truck mounted booms

5. Beam trolley

B. Mechanical advantage systems

1. Hand cranked mechanical winches with cable

PRESENTATION	APPLICATION
2. Rope and pulley systems	
NOTE: When lifting entrants powered equipment is never used because resistance cannot be felt.	
C. Fall restraint systems	
1. Inertia or centrifugal systems	
a) Maximum 2' drop allowed	
2. Cam systems	
a) Gibbs ascender	
b) Rescue ascenders	
D. Entrant/victim harnesses	
1. Full body harnesses (Class III)	
2. Wristlets	
3. Upper body immobilization devices	
a) LSP halfback	
b) Oregon Spine Splint	
4. Full body immobilization devices	
a) Stokes litter	
b) Sked sled	
5. Miscellaneous hardware	
a) Pulleys	
b) Carabiners	

SUMMARY:

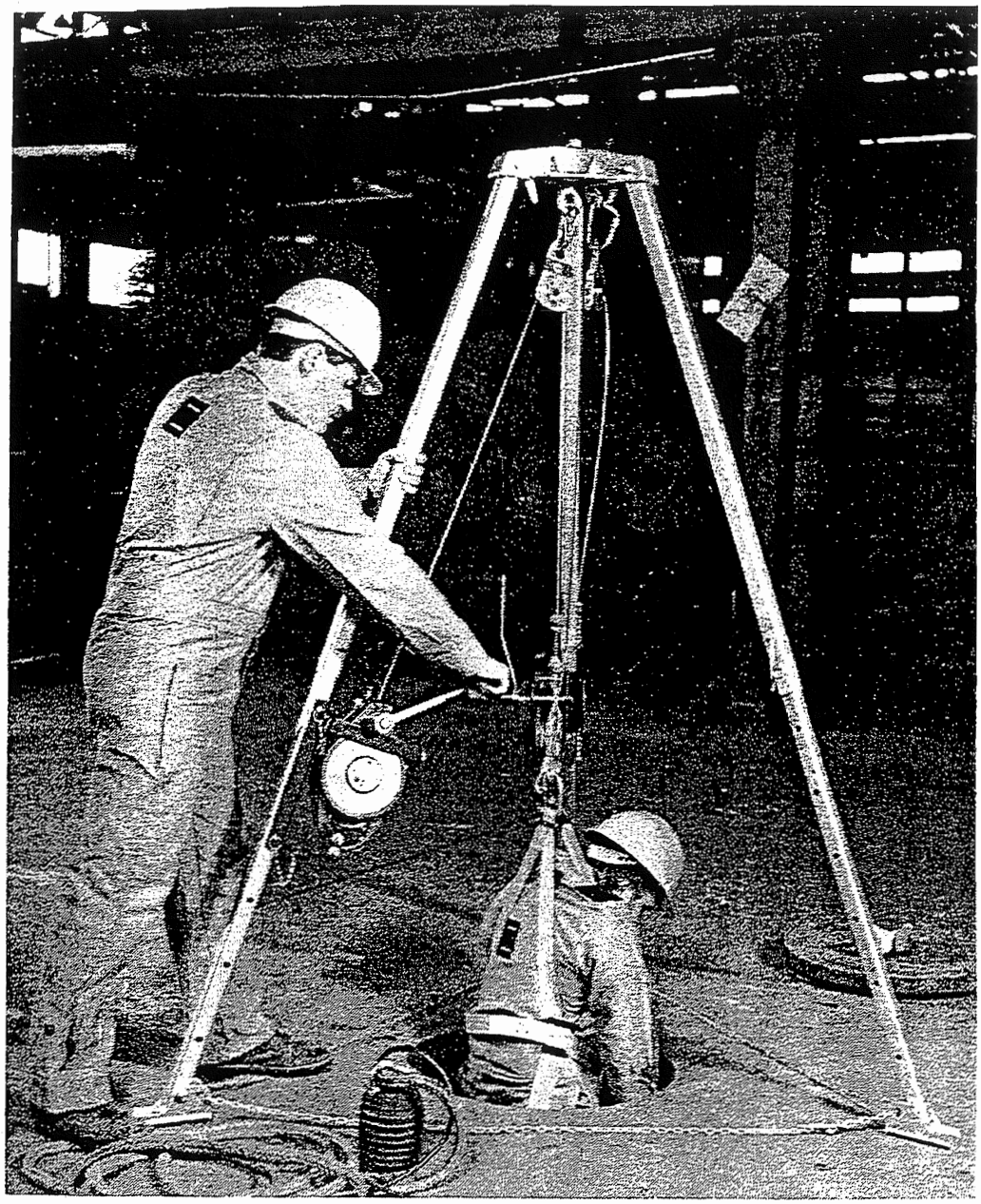
Use of approved retrieval equipment allows for the possibility of non-entry rescues. Non-entry rescues eliminate the risks that rescuers are subjected to when forced to make entry rescues. The equipment used for entrant retrieval and fall restraint can be quite complex or can be simply constructed from common rope systems. Regardless what type of system you use it must fasten to the entrant on a full body harness at a high point in the center of the back or above their head. In addition the system must provide fall restraint in case the entrant was to slip or fall, and provide some type of mechanical device to assist in raising or retrieving the entrant.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.



TOPIC: **Permit Required Confined Space Operational Positions and Responsibilities**

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: I

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will

- identify the three operational positions identified by OSHA
- recognize the duties of each of the three positions identified

Standard: With a minimum of 80% accuracy according to Information Sheet 1-1, Pages 24 & 25 and Title 8, CCR, GISO, February 1994, Sections 5156, 5157, 5158

MATERIALS NEEDED:

- Writing board with markers/erasers
- Overhead projector and screen
- Overhead transparencies for this lesson plan
- Written quiz

REFERENCES:

- Information Sheet 1-1, Pages 24 & 25
- Title 8, California Code of Regulations (CCR), General Industry Safety Orders (GISO), February 1994, Sections 5156, 5157, 5158
- Worker Deaths in Confined Spaces, National Institute for Occupational Safety and Health (NIOSH), January 1994

PREPARATION: OSHA identifies three main operational positions to perform the tasks that must be done to safely operate in confined spaces. Each of the positions have duties which are outlined in Title 8 CCR GISO Section 5157(h), (i) and (j). These positions fit easily into the normal fire service incident command system chart and must be identified and filled in confined space rescue operations as well as industrial purposes.

PRESENTATION	APPLICATION

OHT 9-1

I. DUTIES OF ATTENDANTS

A. Knows hazards faced during entry, including mode, signs/symptoms and consequences of exposure

B. Understand behavioral effects of exposure on entrants

C. Maintains count and identities of personnel in the space

D. Remains outside the space until relieved, may also perform rescue if trained and equipped as required

E. Communicates with entrants as needed

F. Monitors activities inside and outside the space and orders evacuation if conditions dictate

G. Initiates on-site rescue procedures and summons additional rescue services if needed

H. Secures a safe perimeter and takes action if unauthorized persons approach

I. Performs non-entry rescues or other rescue services as designated by the on-site rescue procedure

J. Performs no duties that might interfere with primary duty to protect the entrant

OHT 9-2

II. DUTIES OF AUTHORIZED ENTRANTS

A. Knows hazards during entry, including mode, signs/symptoms and consequences of exposure

B. Properly uses all equipment required to make safe entry

PRESENTATION	APPLICATION
C. Communicates with attendant as necessary for attendant to monitor entrant status and activate evacuation	
D. Alerts attendant if situations warrant	
E. Exits the space immediately if situations warrant	
OHT 9-3	
III. DUTIES OF ENTRY SUPERVISORS	
A. Knows hazards during entry, including mode, signs/symptoms and consequences of exposure	
B. Verifies that entry permit is completed, tests have been conducted, and needed equipment is present before endorsing the permit and approving entry	
C. Terminates the entry and cancels the permit	
D. Verifies that additional equipment and services are present	
E. Confirms that entry operations remain consistent with entry permit, that acceptable entry conditions are maintained, and consistent transfer of responsibility takes place	
NOTE: Due to the common problem of a shortage of staff at a rescue scene, it is recommended that attendants, entrants, and entry supervisors be trained identically, allowing flexibility of personnel assignment.	

SUMMARY:

OSHA requires that the employer provide training so that all employees working in confined spaces acquire the understanding, knowledge, and skills necessary for safe performance of the duties they are assigned. In addition OSHA identifies three positions to operate within confined spaces, attendants, authorized entrants, and entry supervisors. Each one of these positions have specific responsibilities. When these positions are filled and performed as required the chances of accidents and oversights are greatly reduced.

EVALUATION:

The student will be evaluated in accordance with stated performance objectives at a time to be determined by the instructor.

ASSIGNMENT:

Review your notes and appropriate pages in your handbook or Information Sheets in order to prepare yourself for the upcoming quiz. Study for our next session.

DUTIES OF ATTENDANTS

- Know the hazards
- Be aware of behavioral effects of hazards in entrants
- Continuously maintain accurate count and identities of entrants
- Remain outside permit space until relieved by another attendant
- Communicate with entrants to monitor status and alert entrants of need to evacuate
- Monitor activities inside/outside the permit space to determine if it is safe
- Summon rescue or other emergency services
- Deal with unauthorized persons
- Perform non-entry rescues as specified
- Perform no duties that might interfere with primary duty to monitor and protect entrants

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DUTIES OF AUTHORIZED ENTRANTS

- Know the hazards
- Properly use equipment
- Communicate with the attendant
- Alert the attendant to problems
- Exit the permit space when necessary

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DUTIES OF ENTRY SUPERVISORS

- Know the hazards
- Verify entry permit information
- Terminate entry and cancel permits as required
- Verify rescue service and communication available
- Remove unauthorized individuals
- Assure consistent transfer of responsibility

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APPENDIX A

Quiz Answer Sheet Key

INSTRUCTIONS **This is a multiple choice quiz. For each of the following questions or statements, draw a circle around the letter preceding the one best answer on the separate answer sheet.**

EXAMPLE

According to CAL-OSHA, entry into a confined space has occurred when

a. you don your respiratory protection.
b. any part of the entrants body breaks the plane of an opening into the confined space.
c. the Entry Supervisor declares you the entrant.
d. a hazardous atmosphere has been determined to exist by use of atmospheric monitoring.

ANSWER SHEET

a (b) c d

---

1. Employers in California, with employees entering permit required spaces need to be concerned with complying with the following standards

   a. A.N.S.I. guidelines
   b. N.I.O.S.H. guidelines
   c. CAL-OSHA guidelines
   d. All of the above

2. N.I.O.S.H. and other studies reveal that rescuers constitute as many as _____% of the deaths in confined spaces.

   a. 10%
   b. 30%
   c. 40%
   d. 60%

3. What is the leading cause of fatalities in confined spaces?

   a. Engulfment
   b. Hazardous atmospheres
   c. Heat stress
   d. Struck by falling objects

4. Which one of the following is one of the two groups of confined spaces?

   a. Below grade confined spaces
   b. Above grade confined spaces
   c. Mobile confined spaces
   d. Permit required confined spaces

5. Which one of the following is ***not*** a characteristic of a permit required confined space?

   a. Oxygen level at 21%
   b. Contains material that can engulf the entrant
   c. Has the potential to contain a hazardous atmosphere
   d. Contains any recognized serious health or safety hazard

6. Which one of the following is ***not*** a potential effect of hazardous atmospheres in confined spaces?

   a. Suffocation
   b. Hearing deficit
   c. Poisoning
   d. Explosion / fire

7. All but one are the most common gases found in confined spaces

   a. carbon monoxide
   b. oxygen
   c. hydrogen sulfide
   d. chlorine

8. Which one of the following statements regarding gases is ***incorrect***?

   a. Methane is colorless and odorless
   b. Carbon monoxide is nearly equal to air in vapor density
   c. Methane is heavier than air
   d. Hydrogen sulfide is heavier than air

9. When performing pre-entry atmosphere monitoring, the first thing monitored for should be

   a. potential dusts
   b. flammable gases
   c. potential toxic concentrations
   d. oxygen content

10. Acceptable accuracy of monitor readings is assured by

   a. using multiple monitors
   b. replacing monitors regularly
   c. calibrating regularly
   d. nothing, there is no way to insure accuracy

11. Physical hazards can include all of the following ***except***

   a. toxic gases
   b. grinding equipment
   c. mulching equipment
   d. falling objects

12. N.I.O.S.H. studies reveal that during a 10 year period as many as _____ people died from mechanical asphyxiation.

   a. 90
   b. 105
   c. 227
   d. 600

13. Common materials involved in engulfment accidents include all of the following ***except***

   a. grain
   b. sand
   c. gravel
   d. steam

14. A common cause of engulfment accidents is when unstable material collapses under the entrant creating a void. This is referred to as

    a. breakaway
    b. bridging
    c. hidden collapse
    d. sinking floor

15. Target industries for physical and engulfment hazards in confined spaces would include all of the following ***except***

    a. grain processing
    b. industries with mechanized assembly equipment
    c. industries that have spaces with top load applications
    d. electronics repair facilities

16. A lock-out/tag-out program provides a means for isolating which one of the following

    a. electricity
    b. gravity flow of product
    c. steam
    d. all of the above

17. Lock-out/Tag-out procedures are to be performed by

    a. entrants only
    b. entry supervisors only
    c. authorized employees
    d. any employee

18. Which one of the following is ***not*** an example of lock-out/tag-out procedures?

    a. Electrical switch turned off
    b. Drive mechanisms disconnected
    c. Hydraulic lines blocked & bled
    d. Liquid valves chained & locked

19. Entry permits must be approved and cancelled by the

    a. entrant
    b. employer
    c. attendant
    d. entry supervisor

20. Entry permits must be filed and retained for a minimum of

    a. 1 years
    b. 2 year
    c. 5 years
    d. 6 months

21. Which one of the following is considered to be equipment used to perform ventilation procedures in confined spaces?

    a. Industrial fans / ventilators
    b. Smoke ejector fans
    c. Duct work
    d. All of the above

22. Ventilation procedures should

    a. begin following removal of the victim
    b. begin prior to atmosphere monitoring
    c. begin prior to entry and continue throughout the operation
    d. be performed using natural ventilation

23. Common ventilation plan(s) include forced

    a. supply
    b. exhaust
    c. supply & exhaust
    d. all of the above

24. Which one of the following considerations will impact the level at which you will attempt to exhaust gases from a confined space.

    a. Wind direction
    b. Number of openings
    c. Vapor density of suspected vapors
    d. All of the above

25. One of the biggest concerns when ventilating an atmosphere that is above the UEL (upper explosive limit) of a vapor is

    a. opening locations
    b. changing a non explosive atmosphere into an explosive atmosphere
    c. monitoring intervals
    d. vessel type

26. Self contained breathing apparatus (SCBA) has limited application in confined space operations due to

    a. cylinder size
    b. air quality
    c. duration of air supply
    d. a and c

27. The respiratory protection system commonly considered best suited for confined space rescue is

    a. combination / dual purpose self contained breathing apparatus
    b. air purifying respirators
    c. self contained breathing apparatus
    d. supplied air respirator with escape cylinder

28. The respiratory protection type ***not*** recommended unless conditions are known and can be maintained is

    a. air purifying respirator
    b. self contained breathing apparatus
    c. dual purpose SCBA
    d. supplied air respirator

29. The biggest disadvantage to supplied air respiratory systems is

    a. air line limitation of 300'
    b. continuous supply of air
    c. umbilical air line
    d. a and c

30. Supplied air respiratory systems must be equipped with

    a. quick fill attachments
    b. escape cylinders
    c. high pressure Aux. cylinders
    d. demand valve capability

31. When performing confined space operations it is critical to have reliable communications between the

    a. attendant and entrant
    b. entrant and entry supervisor
    c. attendant and industrial Hygienist
    d. attendant and back-up entrants

32. In normal confined space operations communications equipment

    a. is optional
    b. can consist of rope signals
    c. can consist of hard wire systems
    d. b and c

33. Part of your communications plan should include

    a. back-up plans
    b. the type of communications to be used
    c. how additional help will be summoned
    d. all of the above

34. Battery operated, voice activated communications systems are frequently used because

    a. they're fail safe
    b. they are the most simple system
    c. they allow the entrant to move freely & don't require use of hands
    d. they are the clearest communication available

35. Hardwire communications systems can

    a. provide clear communications
    b. be cumbersome due to tag lines included
    c. be good because they are not affected by poor reception
    d. all of the above

36. O.S.H.A. requires retrieval lines and fall restraint when vertical entries of _____ feet or more are made.

    a. 3
    b. 5
    c. 8
    d. 10

37. Entrants are required to stay "on line" when making vertical entries unless

    a. this would increase entrant risk of injury or is impossible
    b. you need to remove the line to raise the victim m
    c. you don't have enough line
    d. none of the above

38. When lifting or raising entrants, powered equipment is

    a. used to decrease lift time
    b. more efficient
    c. capable of raising equipment and personnel at once
    d. never used because resistance cannot be felt

39. Chest or full body harnesses with a connection point high on the back is commonly used for entrants because

    a. the entrant cannot disconnect the line themselves
    b. the entrant presents the smallest possible profile
    c. the retrieval line will not be in the entrants face
    d. other equipment must be attached in the front

40. In extremely tight openings, and with unresponsive victims _____ harnesses are sometimes used.

    a. wristlet
    b. helmet
    c. pelvic
    d. improvised

41. An exact count and identities of all entrants in the confined space must be maintained by the

    a. entry supervisor
    b. employee representative
    c. back-up entrants
    d. attendant

42. Who is responsible for approving and cancelling all entry permits?

    a. The entrant
    b. The entry Supervisor
    c. The attendant
    d. The employee representative

43. The person(s) charged with removing or dealing with unauthorized persons around the site

    a. the entrant
    b. the entry supervisor
    c. the attendant
    d. b and c

44. The person(s) charged with confirming that conditions remain consistent with the permit is the

    a. attendant
    b. entrant
    c. back-up entrant
    d. entry supervisor

45. The three main positions identified by OSHA to handle confined space operations are

    a. attendant, entrant, perimeter control officer
    b. medical officer, rescue officer, triage officer
    c. entry supervisor, entrant, attendant
    d. back-up entrants, back-up supervisor, back-up attendants

NAME _____

DATE _____

CONFINED SPACE AWARENESS QUIZ
ANSWER SHEET

1.	a	b	c	d	16.	a	b	c	d	31.	a	b	c	d
2.	a	b	c	d	17.	a	b	c	d	32.	a	b	c	d
3.	a	b	c	d	18.	a	b	c	d	33.	a	b	c	d
4.	a	b	c	d	19.	a	b	c	d	34.	a	b	c	d
5.	a	b	c	d	20.	a	b	c	d	35.	a	b	c	d
6.	a	b	c	d	21.	a	b	c	d	36.	a	b	c	d
7.	a	b	c	d	22.	a	b	c	d	37.	a	b	c	d
8.	a	b	c	d	23.	a	b	c	d	38.	a	b	c	d
9.	a	b	c	d	24.	a	b	c	d	39.	a	b	c	d
10.	a	b	c	d	25.	a	b	c	d	40.	a	b	c	d
11.	a	b	c	d	26.	a	b	c	d	41.	a	b	c	d
12.	a	b	c	d	27.	a	b	c	d	42.	a	b	c	d
13.	a	b	c	d	28.	a	b	c	d	43.	a	b	c	d
14.	a	b	c	d	29.	a	b	c	d	44.	a	b	c	d
15.	a	b	c	d	30.	a	b	c	d	45.	a	b	c	d

CONFINED SPACE AWARENESS LEVEL QUIZ

KEY

1.	D	16.	D	31.	A
2.	D	17.	C	32.	D
3.	B	18.	A	33.	D
4.	D	19.	D	34.	C
5.	A	20.	A	35.	D
6.	B	21.	D	36.	B
7.	D	22.	C	37.	A
8.	C	23.	D	38.	D
9.	D	24.	D	39.	B
10.	C	25.	B	40.	A
11.	A	26.	D	41.	D
12.	C	27.	D	42.	B
13.	D	28.	A	43.	D
14.	B	29.	D	44.	D
15.	D	30.	B	45.	C

KEY

Question	Answer	Source*	Question	Answer	Source*
1	D	27			
2	D	26	28	A	21
3	B	3	29	D	21
4	D	1	30	B	21
5	A	1	31	A	23
6	B	4, 7-9	32	D	23
7	D	7-10			IS 1-2, 13
8	C	6	33	D	23
9	D	11			IS 1-2, 13, 15,
10	C	15			16
11	A	15	34	C	23
12	C	15	35	D	23
13	D	15	36	B	IS 1-2, 8
14	B	15	37	A	IS 1-2, 8
15	D	15	38	D	24
16	D	19	39	B	24
17	C	19			IS 1-2, 8
18	A	19	40	A	24
19	D	16	41	D	26
20	A	16	42	B	16 & 27
21	D	17			IS 1-2, 7
22	C	17	43	D	26
23	D	17			IS 1-2, 7
24	D	17	44	D	25
25	B	17			IS 1-2, 7
26	D	20	45	C	25 & 26
27	D	21			IS 1-2, 7

* Page numbers refer to Information Sheet 1-1 unless otherwise indicated.
IS 1-2 refer to Information Sheet 1-2

APPENDIX B

21 Slides