

TABLE OF CONTENTS

I.	Foreword	i
II.	Introduction	1
III.	Definition	1
IV.	Examples	2
V.	Hazards in Confined Space	4
VI.	Control of Hazards	8
VII.	Confined Space Entry Program	13
VIII.	Appendix:	
	Annex A: Checklist	19
	Annex B: Sample of Tags	23
	Annex C: Sample of Permit to Enter a Confined Space	24
IX.	References	25

OSHC Mission

*Established as the nationally recognized authority on research, training and technical expertise, the **OSHC** pursue in partnership with the public and private sectors the attainment of a healthy and safe working environment through: responsive and sustainable **OSH** programs and policies; effective delivery of quality **OSH** services; client focused responses; and mutually beneficial linkages and networks.*

For more information please contact:

The Safety Control Division

Occupational Safety and Health Center

North Avenue corner Agham Road, Diliman, Quezon City

Tel. Nos.: 928-6755 or 924-2414

Fax No.: 929-6030

E-mail: oshcenter@oshc.dole.gov.ph

Website: <http://www.oshc.dole.gov.ph>

CEBU BRANCH OFFICE

6th Floor Insular Life Building Gorordo Avenue
corner General Maxilom Avenue, Cebu City

Te. Nos.: (032) 236-4674 / 234-3305

E-mail: oshccebu@yahoo.com

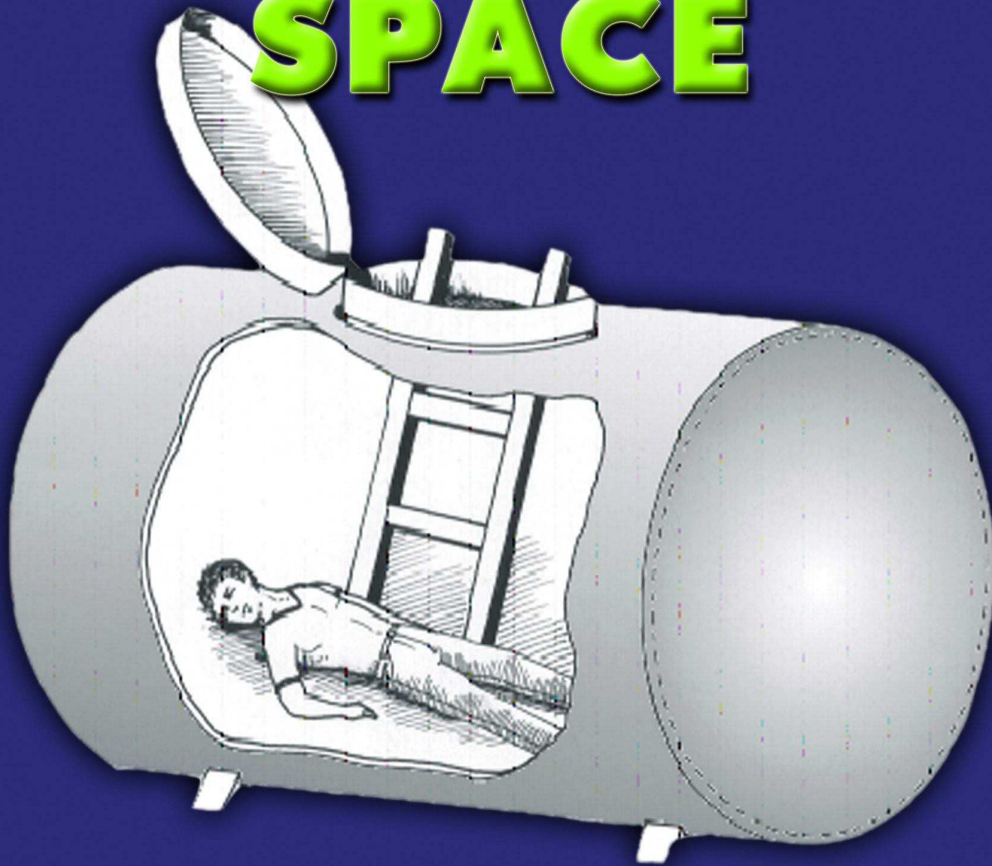
CAGAYAN DE ORO BRANCH OFFICE

3rd Floor Gonzalo Go Building, Corrales Avenue,
Cagayan De Oro City

Telefax: (088) 851-1233 / (08822) 721316

E-mail: oshccdo@gmail.com

SAFETY IN CONFINED SPACE



Republic of the Philippines
DEPARTMENT OF LABOR AND EMPLOYMENT
OCCUPATIONAL SAFETY AND HEALTH CENTER



INTRODUCTION

Entering and working in confined spaces pose serious and immediate threats to the lives and well being of employees. People die or are injured in confined spaces because:

- They are not familiar with confined spaces and its hazards and dangers.
- They underestimate the danger of working in confined spaces and are often unaware of how quickly they can be affected by toxic substances or exposed to deadly situations.
- They try to rescue fellow workers without the necessary safety equipment and appropriate training on rescue procedures.

This manual was developed to ensure the safety of personnel required to enter and work in confined spaces through:

- A better understanding of different confined spaces;
- Familiarization with its hazards;
- Knowledge in controlling the hazards;
- Development of program on confined space entry .

DEFINITION

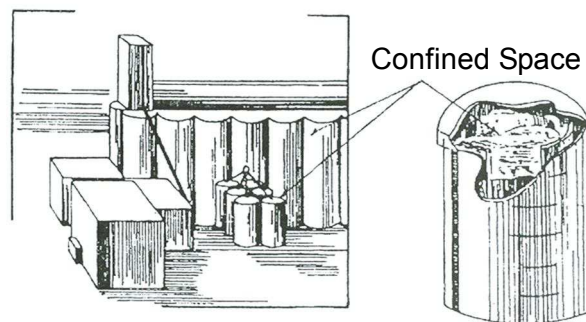
A confined space has the following characteristics:

- Large enough that a worker can bodily enter and perform assigned work;
- Has limited or restricted means for entry or exit where unfavorable natural ventilation may exist;
- Not designed for continuous occupancy of workers.

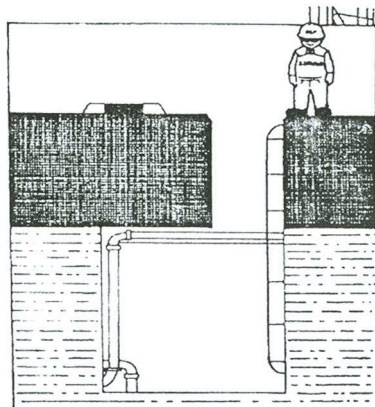
Examples of Confined Space:

1. Sewers
2. Manholes
3. Tanks
4. Vessels
5. Silos
6. Bins
7. Vats
8. Sludge Digestion Systems
9. Tunnels
10. Pump wet wells
11. Ship Compartments
12. Lift Stations
13. Utility Vaults
14. Mechanical rooms

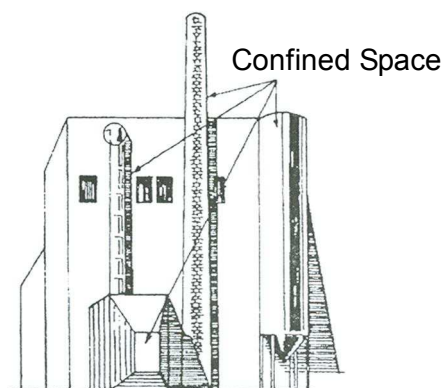
Figure 1: Examples of Confined Space



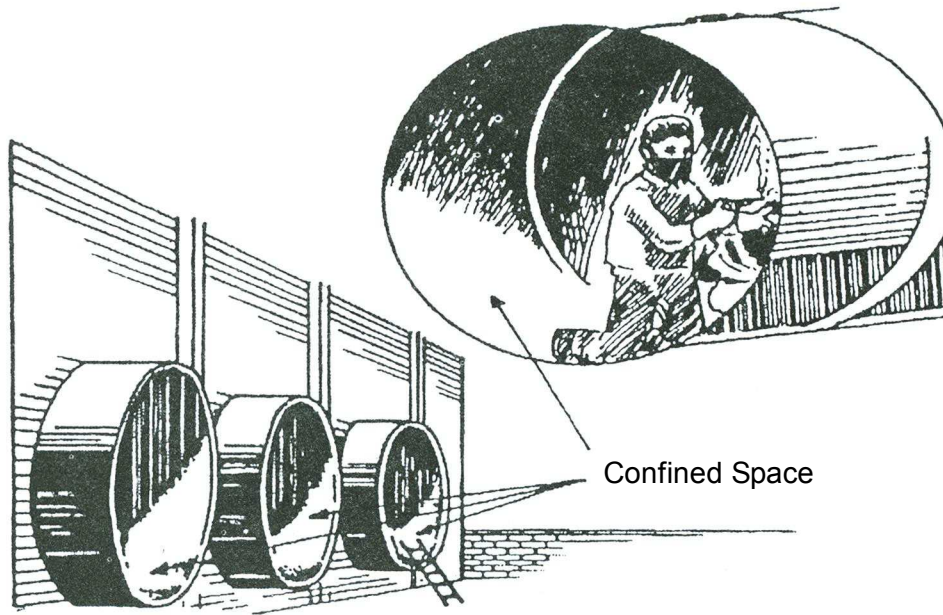
Silos Grains & Binhoppers



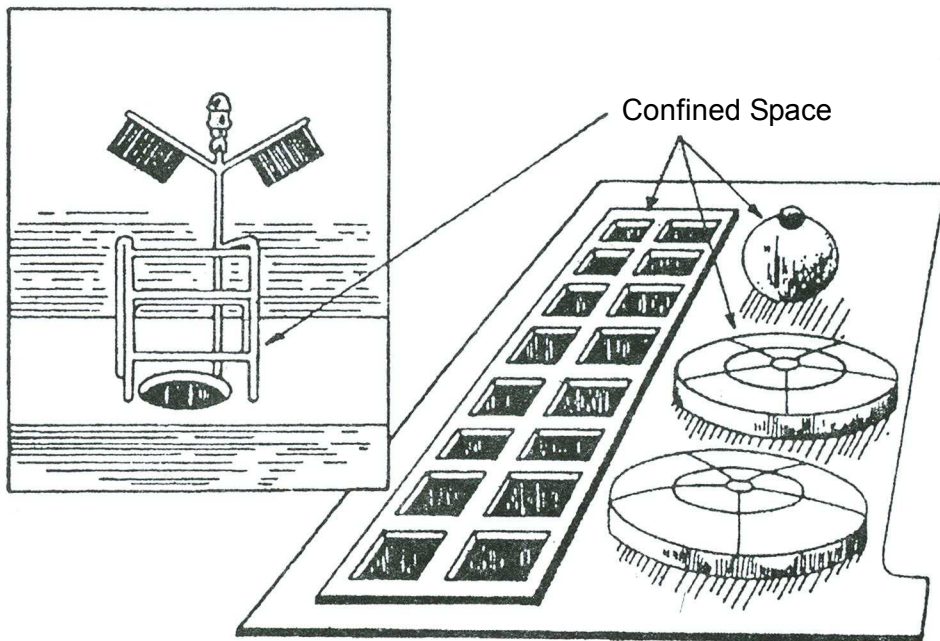
Underground Utility Vault



**Ventilation ducts,
Reactor & Process Vessels**



Tunnel and Pipelines



Sludge Digestion System

HAZARDS OF CONFINED SPACE

1. Oxygen Deficiency

Air is considered oxygen deficient when the oxygen content is less than 19.5% by volume. The oxygen level in a confined space can decrease as a result of consumption or displacement by inert gases such as carbon dioxide or nitrogen. Work processes such as welding, cutting or brazing, and certain chemical reactions such as rusting and bacterial reaction (fermentation) can also reduce oxygen concentration.

2. Flammable atmospheres

Flammable or explosive atmosphere results from:

- a. An oxygen enriched atmosphere exists where the oxygen in the air is greater than 21%. An oxygen enriched atmosphere will cause flammable materials such as clothing and hair to burn violently when ignited.
- b. Flammable gas, vapor or dust in proper proportion. Work being conducted in a confined space can generate a flammable atmosphere. Examples are spray painting, coating or use of flammable solvents for cleaning. Welding or cutting operations using oxyacetylene equipment can also cause explosion in confined space. Atmosphere is considered unacceptable if a flammable gas, vapor or mist is in excess of 10% of Lower Flammability Limit (LFL). Combustible airborne occur when dust concentration meets or exceed its LFL.

3. Toxic atmospheres

Toxic atmospheres are those which contain toxic substances in a concentration that exceeds the Threshold Limit Value (TLV), as specified in the Occupational Safety and Health Standards or Material Safety Data Sheet of that substance.

Toxic substances in atmosphere may come from the following:

- a. Products stored in the confined space
Products stored in confined space can be absorbed in walls and let off toxic vapors when removed or when cleaning residual materials.

- b. Work being performed in a confined space
Ex. welding cutting, brazing, painting, scraping, sanding, degreasing, etc.
- c. Areas adjacent to the confined space
Toxic substances produced by work in a nearby area can enter and accumulate in a confined space.
Example: exhaust fumes from internal combustion engines placed near the manhole.

Workers can be trapped and die of exposure or suffocation before anyone would know they are missing.



Figure 2: During removal of sludge from a tank, decomposed material can let off deadly hydrogen sulfide gas.



Figure 3: Fumes from welding workks are very toxic in a confined space.

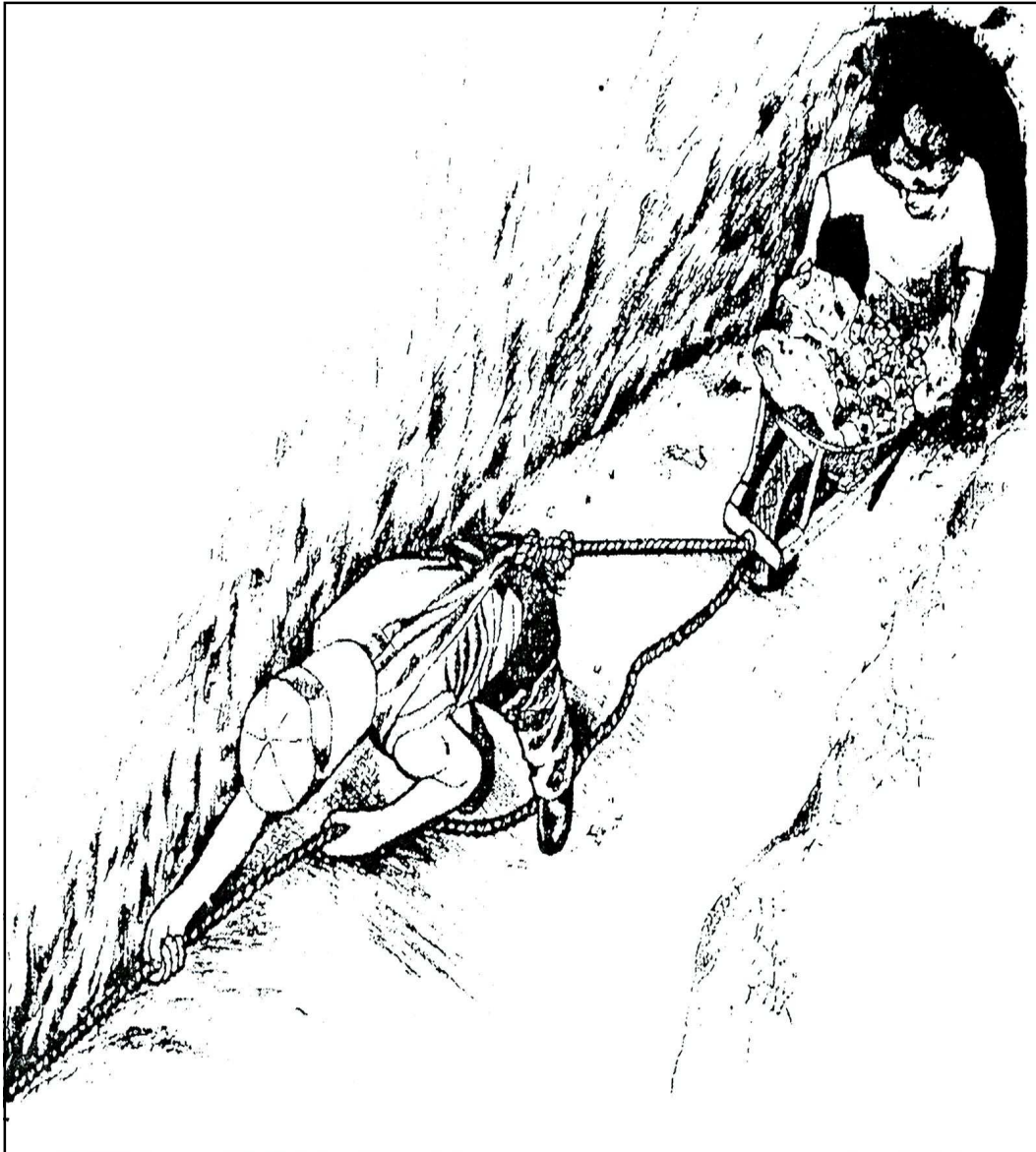


Figure 4: Workers in small scale mining area exposed to danger of collapse, cave - in, oxygen deficiency and other physical hazards.

4. Mechanical and Physical Hazards

- a. Rotating or moving mechanical parts or energy sources can create hazards within a confined space.
- b. Physical factors such as heat, cold, noise, vibration and fatigue can contribute to accidents.
- c. Loose materials such as, fine coal, sawdust or grains can engulf and suffocate the workers.

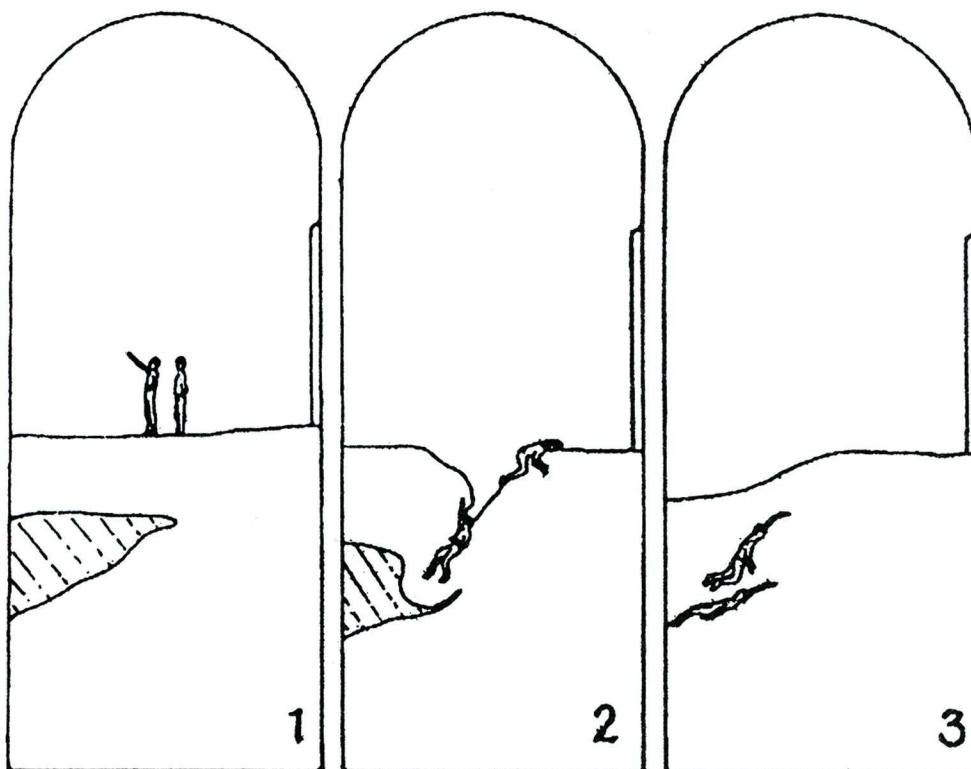


Figure 5: The hazard of Engulfment in Unstable Material

CONTROL OF HAZARDS

1. Testing and monitoring of atmospheres

It is necessary to test all areas (top,middle,bottom) of a confined space with properly calibrated testing instruments to determine oxygen concentration and the presence of toxic gases. If testing reveals oxygen deficiency or the presence of toxic gases or vapors, Material Safety Data Sheet (MSDS) or other chemical information of such substances must be obtained in order to determine the potential health effects, the Treshold Limit Value (TLV) and any other information needed to safely perform the work.

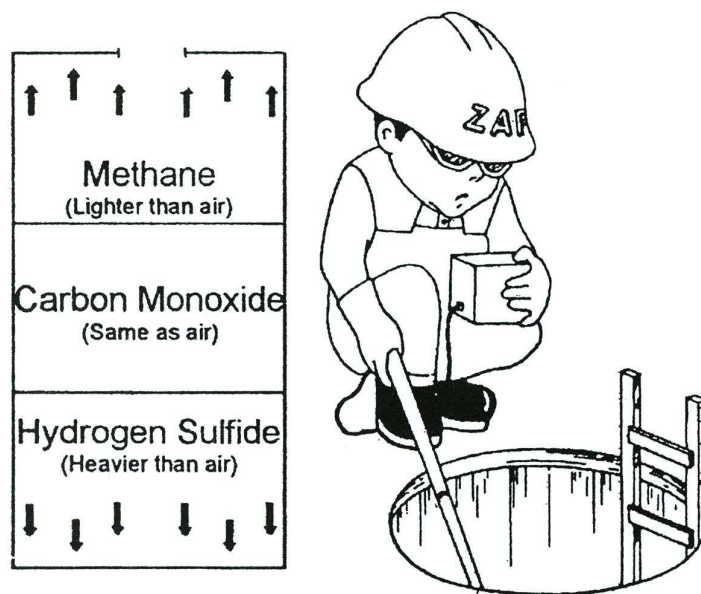


Figure 6: Test all areas of confined space (top, bottom, middle)

2. Purging

Purging displaces the toxic air in a confined space through steam, air, water or inert gas.

3. Isolation

Isolation of a confined space is a process where the space is removed from service and completely protected against the release of energy into the space.

It is accomplished through:

- a. Lock out - All mechanical equipment in a confined space must be disconnected from the power source at the panel board and the controls "locked out" to prevent accidental start-up. This includes electrical, mechanical, steam, compressed gas, hydraulic and gravity. There shall only be one (1) key for the lock in the possession of the worker. A tag - out should accompany the lock to identify operation and prohibition.

The process is illustrated in Figure 7 and 8 below.

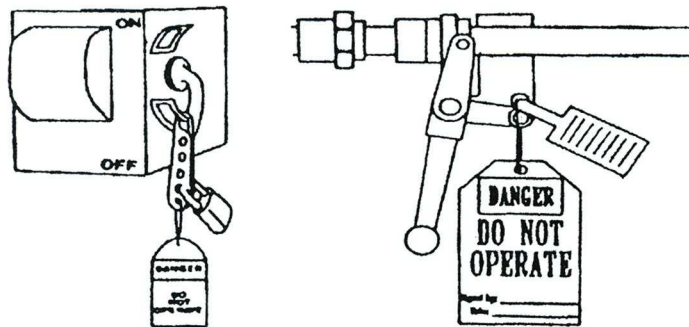


Figure 7: Example of lock-out/tag-out practice

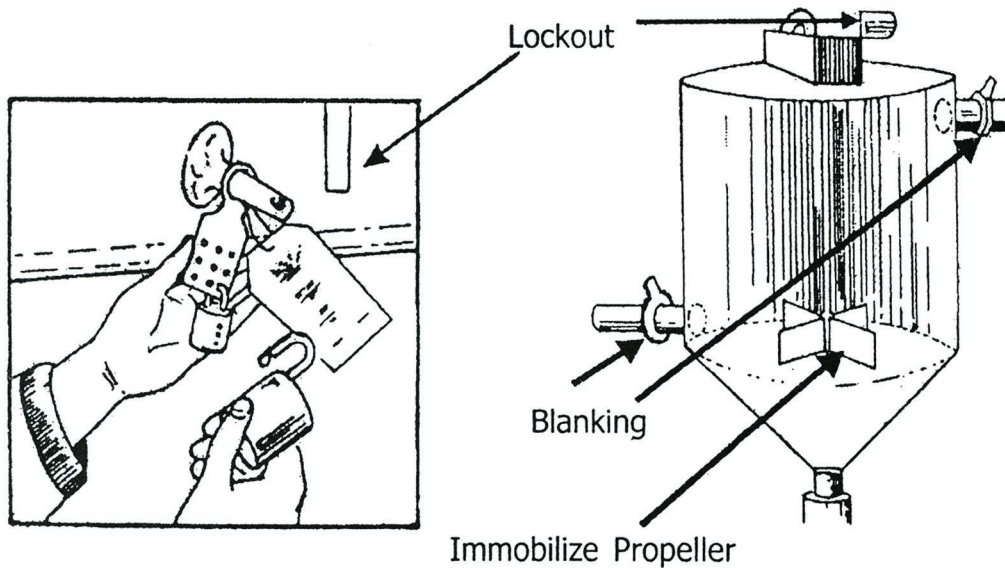


Figure 8: Controls are lock-out to prevent accidental start-up

- b. Blanking and bleeding - All lines and systems which may permit the entry of hazardous materials into confined space must be blanked off. Blanks used to seal off lines shall be capable of with standing the maximum working pressure and corrosion properties of the materials.

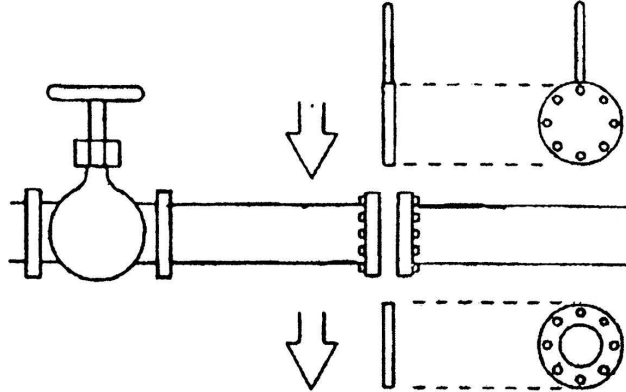


Figure 9: Method of Blanking Hydraulic/Pneumatic Lines

- c. Disconnecting - Mechanical isolation of moving parts can be accomplished by disconnecting linkages or removing drive belts or chains. Equipment with moving mechanical parts can also be blocked in such a manner that there is no possibility of accidental rotation.

4. Use of Personal Protective Equipment (PPE)

A worker entering a confined space must be equipped with appropriate PPE relative to the hazard present in the confined space. If there is a likelihood of accidental exposure to toxic substances and traumatic injury, whole body protection must be considered.

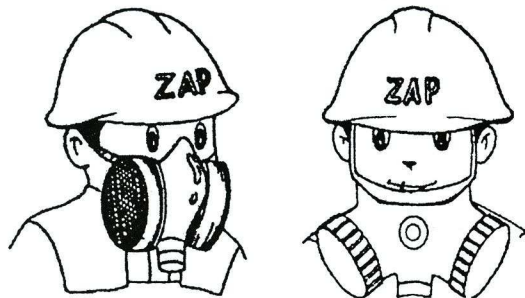
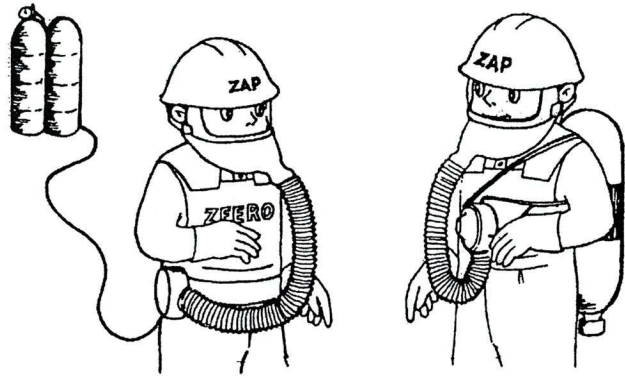


Figure 10: Air Purifying Respirators



Supplied Air Respirator with Auxiliary, Escape-only SCBA Self-Contained Breathing Apparatus (SCBA)

Figure 11: Air Supplying Respirators

5. Training

Training of workers for entering and working in confined space is essential to familiarize them with potential hazards, the proper use of life saving equipment and emergency procedures.

6. Stand-by/Rescue

A standby person should be assigned to stay outside the confined space and be in constant communication with the workers inside. The standby person should not have any other duties but to serve as lookout and launch an alert in case of emergency. Standby personnel should not enter a confined space until help arrives and then only with the proper protective equipment.

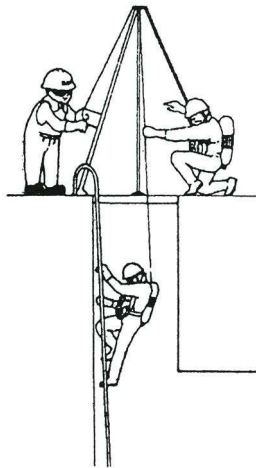


Figure 12: Entry with hoist and Standby Personnel

7. Permit System

A Confined Space Entry Permit is a written authorization to enter and work in confined spaces; it clearly states all known or potential hazards, and identifies the safety equipment required to ensure the safety of the worker. (Refer to Annex C - for sample of Confined Space Entry Permit).

8. Ventilation

Ventilation by a blower or fan may be necessary to supply fresh air to breathe and to remove harmful gases and vapors from a confined space.

A ventilation system may be either mechanical, natural or combination of both, depending upon the size and shape of the confined space and the work to be performed.

However, precautions should be taken since ventilation systems can cause problems such as;

- a. They can feed contaminated air into the confined space, therefore, make sure that the air being supplied is clean.
- b. They can block exits.
- c. In an explosive atmosphere, ventilation can be an ignition source. If the ventilation system is exhausting flammable vapors, it must be explosion proof.

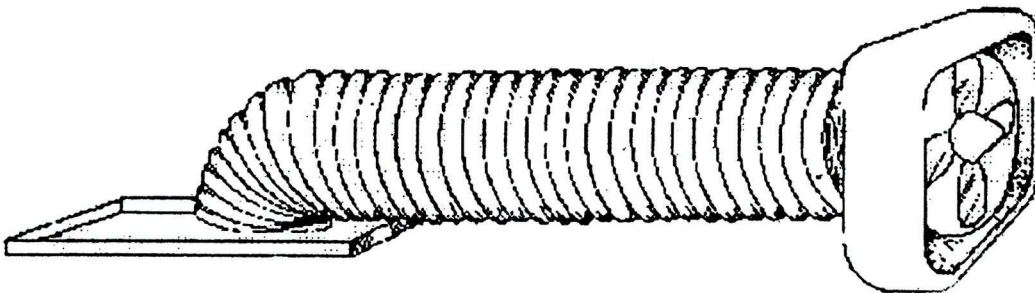


Figure 13: Ventilating with fan and trunk hose

CONFINED SPACE ENTRY PROGRAM

This Program is designed to protect employees from working inside the confined space that may contain physical hazards or toxic atmosphere.

1. Responsibilities

a. Management

- * Ensure proper training for entry & rescue teams.
- * Provide proper equipment for entry & rescue teams.
- * Ensure confined space assessments have been conducted.
- * Ensure all permit required confined spaces are posted.
- * Annually review this program and all Entry Permits.
- * Evaluate Rescue Teams / Services to ensure they are adequately trained and prepared.
- * Ensure rescue team at access during entry into spaces with IDLH (Immediately Danger to Life and Health) atmosphere.

b. Employees

- * Follow program requirements.
- * Report any previously un-identified hazards associated with confined space.

c. Entry Supervisor

- * Responsible for the overall permit space entry. Coordinate all entry procedures, tests, permits, equipment and other relevant activities.
- * Know the hazard that may be faced during entry.
- * Terminate the entry and cancel the permit when the entry is complete and there is a need for terminating the permit.

d. Stand-by Personnel

- ✧ To know the hazards that may be faced during entry.
- ✧ To be aware of the possible behavioral effects of hazard exposure on entrants.
- ✧ To continuously maintain an accurate count of entrants inside the space.
- ✧ To remain outside the permit space during entry operations until relieved by another attendant.
- ✧ To monitor entrants status and alert him of the need to evacuate.
- ✧ To monitor activities inside and outside the confined space.
- ✧ Know the hazards that may be faced during entry including information on the mode of the signs or symptoms, and consequences of the exposure.
- ✧ To summon rescue and other emergency services as escape the confined space.
- ✧ Not to perform duties that might interfere the stand-by personnel's primary duty.

e. Entrants

- ✧ Know the hazards that may be faced during entry, including information on the mode of the signs or symptoms, and consequences of the exposure.
- ✧ Properly use the protective equipment required for safe entry.
- ✧ Communicate with the stand-by personnel as necessary to enable the stand-by personnel monitor his status.
- ✧ Alert the attendant of any symptoms of dangerous situation or prohibited condition.

- ✳ Exit the confined space as quickly as possible whenever the attendant or entry supervisor gives an order to evacuate the confined space.

2. Identifying all confined spaces

All confined spaces located within the premises should be identified. All workers shall be made aware of these confined spaces through training or instruction provided by the supervisor, department head or safety officer.

3. Preventing Unauthorized Entry

All workers shall be instructed that entry into a confined space is prohibited without an authorized permit. (see Annex C) .

4. Permit System

When a confined space must be entered, a permit shall be completed and authorized by the department head or supervisor/safety officer prior to entry in the confined space.

5. Planning the Entry

This will allow for the identification of all hazards and for the determination of all equipment necessary to complete the task.

The following steps are to be taken prior to a safe confined-space entry;

- ✳ Gathering general data
- ✳ Identifying the hazards
- ✳ Ventilating the confined space
- ✳ Isolating the confined space
- ✳ Purging/cleaning the confined space
- ✳ Placement of warning signs
- ✳ Identifying all personnel
- ✳ Identifying necessary equipment

6. Conducting Pre-entry Training

Once the entry has been planned, department heads or their designated representatives must train all workers who will be involved in the entry. The training should be conducted not earlier than one day before entry is to be made.

The following outline should be used for the training:

- a. Identify the confined space, the reason(s) for entry.
- b. Identify the work detail.
- c. Inform entrants of all known or suspected hazards.
- d. Identify isolation procedures.
- e. Identify purging and/or ventilation procedures.
- f. Identify all equipment needed.
- g. Determine necessary personal protective equipment.
- h. Establish communication.
- i. Role of stand-by rescuer.
- j. Pre-plan rescue procedures.
- k. Place the confined space back into service.

7. Preparing the Confined Space for Entry

The following steps are to be followed when preparing the confined space for entry:

- a. If warning signs or barriers are to be used to prevent unauthorized entry or to protect entrants from external hazards, they should be placed on or around the confined space.
- b. Place all tools, safety equipment, monitoring equipment, etc., near the confined space.

- c. Isolate all mechanical and/or electrical hazards.
- d. Purge or ventilate the confined space.
- e. The entry supervisor will test the atmosphere

If oxygen content is less than 19.5% or greater 21.5%, perform additional ventilation. Then, shut off ventilation equipment and re-test the oxygen content.

If oxygen content is between 19.5% and 21.5%, continue entry preparation.

- f. The entry supervisor will test for flammable gas level.

If the meter reading is less than 10% of the lower explosive limit (LEL), continue entry preparations.

If the meter reading is above the 10% of the LEL, continue ventilation of the confined space. Then shut-off the ventilation and continue the atmosphere re-tested.

8. Utilizing Safety Equipment

Where practical, all personnel entering a confined space should be equipped with a retrieval line secured at one end to the entrant by full-body harness with its other end secured to a tripod lifting hoist.

9. Atmospheric Testing Procedures

- a. All testing equipment shall be properly calibrated as instructed by the manufacturer.
- b. All of the manufacturer's operating instructions must be followed.
- c. The test equipment should be tested in a known atmosphere to insure its accuracy.
- d. Ventilation equipment must be shutoff before conducting any atmospheric test.

- e. The atmosphere must be tested at the bottom, top and middle of all confined spaces.
- f. The atmosphere must be continuously monitored while work is being conducted in the confined space.
- g. If the confined space is left for any reason, the atmosphere must be re-tested before re-entering the space.

10. Confined Space Cleaning Procedures

- a. All entrants must be equipped with designated safety equipment
- b. All entrants must be equipped with SCBA
- c. No spark-producing tools will be allowed for use.

11. Rescue Procedures

- a. Attempt to remove the victim by the use of retrieval line from outside the confined space if this can be accomplished without creating further hazard for the entrant or the attendant.
- b. If the standby person is able to remove the victim with the retrieval line, he/she should administer first aid within the limits of his/her training until emergency medical services arrive.
- c. If the standby person is unable to remove the victim by using the retrieval line, he or she must wait for help to arrive. The standby person(s) is not allowed to enter the confined space for any reason.

ANNEX A

(Adapted from the NIOSH Guide to Safety in Confined Space)

CHECKLIST

YES

NO

Is entry necessary?
(If yes please proceed to questions below)

TESTING

Are the instrument used in atmosphere testing properly calibrated?

Was the atmosphere in the confined space tested?

Was oxygen at least 19.5% and not more than 21%?

Were toxic, flammable, or oxygen-displacing gases / vapors present?

Hydrogen Sulfide _____

Carbon Monoxide _____

Methane _____

Carbon Dioxide _____

Others (List) _____

MONITORING

Will the atmosphere in the confined space be monitored while work is going on?

Continuously?

Periodically? (If Yes, give interval)

	YES	NO
CLEANING		
Has been cleaned before entry is made?	<input type="checkbox"/>	<input type="checkbox"/>
Was the space steamed?	<input type="checkbox"/>	<input type="checkbox"/>
If so, was it allowed to cool?	<input type="checkbox"/>	<input type="checkbox"/>
VENTILATION		
Has the space been ventilated before entry?	<input type="checkbox"/>	<input type="checkbox"/>
Will ventilation be continued during entry?	<input type="checkbox"/>	<input type="checkbox"/>
Is the air intake for the ventilation system located in an area that is free of combustible dust and vapors and toxic substance?	<input type="checkbox"/>	<input type="checkbox"/>
If atmosphere was found unacceptable and then ventilated, was it re-tested before entry?	<input type="checkbox"/>	<input type="checkbox"/>
ISOLATION		
Has the space been isolated from other systems?	<input type="checkbox"/>	<input type="checkbox"/>
Has electrical equipment been locked out?	<input type="checkbox"/>	<input type="checkbox"/>
Have disconnects been used where possible?	<input type="checkbox"/>	<input type="checkbox"/>
Has mechanical equipment been blocked, chocked, and disengaged where necessary?	<input type="checkbox"/>	<input type="checkbox"/>
Have lines under pressure been blanked and bled?	<input type="checkbox"/>	<input type="checkbox"/>

	YES	NO
CLOTHING EQUIPMENT		
Is special clothing required? If so, specify _____ _____	<input type="checkbox"/>	<input type="checkbox"/>
Are special tools required? If so, specify _____ _____	<input type="checkbox"/>	<input type="checkbox"/>
PPE		
Are respirators and other PPE of the approved type (tested and certified by the OSHC)?	<input type="checkbox"/>	<input type="checkbox"/>
Can you get through the opening with a respirator on?	<input type="checkbox"/>	<input type="checkbox"/>
TRAINING		
Have you been trained in confined space entry and what to look for?	<input type="checkbox"/>	<input type="checkbox"/>
Have you been trained in proper use of respirator?	<input type="checkbox"/>	<input type="checkbox"/>
Have you received first aid / CPR training?	<input type="checkbox"/>	<input type="checkbox"/>
Have you been trained of emergency preparedness procedure?	<input type="checkbox"/>	<input type="checkbox"/>
STANDBY / RESCUE		
Will there be a stand-by person outside with the constant visual or auditory communication inside the confined space?	<input type="checkbox"/>	<input type="checkbox"/>

	YES	NO
Will the stand-by person be able to see and / or hear the person inside at all times?	<input type="checkbox"/>	<input type="checkbox"/>
Has the stand-by person been trained in rescue procedures?	<input type="checkbox"/>	<input type="checkbox"/>
Will safety lines and harness be required to remove a person?	<input type="checkbox"/>	<input type="checkbox"/>
Are company rescue procedures available to be followed in the event of an emergency?	<input type="checkbox"/>	<input type="checkbox"/>
Are you familiar with emergency rescue procedures?	<input type="checkbox"/>	<input type="checkbox"/>
Do you know whom to notify and how in the event of an emergency?	<input type="checkbox"/>	<input type="checkbox"/>
PERMIT		
Has a confined space entry permit been issued?	<input type="checkbox"/>	<input type="checkbox"/>
Does the permit include a list of emergency telephone numbers?	<input type="checkbox"/>	<input type="checkbox"/>

ANNEX B: Example of Tag

DANGER	
DO NOT OPERATE	
EQUIP NO.	CIRCUIT NO.
DATE	TIME
TAGGED OUT FOR	
<input type="checkbox"/> ELECTRICAL <input type="checkbox"/> T/A <input type="checkbox"/> NEW INSTALLATION <input type="checkbox"/> MACHINIST <input type="checkbox"/> EXPLAIN OTHER	
EQUIP. IS:	
<input type="checkbox"/> DRAINED <input type="checkbox"/> ISOLATED <input type="checkbox"/> DE-ENERGIZED AND SAFE TO WORK ON	
PROCESS OPERATOR / A.O. MUST PRINT & SIGN NAME HERE:	
SIGNATURE: _____	
IF CIRCUIT IS 480 V TO 6900 V DRAW OUT BREAKER OR FUSES, A QUALIFIED EQUIP SECRETARY CRAFTSMAN OR UTILITIES REP MUST RE-ENERGIZED CIRCUIT AND PRINT AND SIGN NAME HERE	
SIGNATURE: _____	DATE
	TIME
RETAIN 24 HRS. AFTER REMOVAL	

DANGER	
DO NOT OPERATE	
All work has been completed and all tags have been removed. I have inspected the equipment and it is safe to place back into service.	
_____ Signature over printed name	
_____ Date and Time	
If Circuit is 480 to 6900 V drawout breaker or fuses, a qualified electrician / personnel must re-energize circuit and print and sign name here.	
_____ Signature over printed name	
_____ Date and Time	
RETAIN 24 HRS. AFTER REMOVAL	

<h1 style="margin: 0;">SWITCH TAG # _____</h1> <p style="margin: 10px 0 0 0; font-weight: bold; font-size: 1.2em;">THIS EQUIPMENT IS DE-ENERGIZED AND TAGGED OUT AT ITS DISCONNECT DEVICE</p>

ANNEX C: Example of Confined Space Entry Permit



OCCUPATIONAL SAFETY AND HEALTH CENTER Confined Space Entry Permit

Date / Time Issued		Valid Until			
Department		Name of Affected Equipment			
Location					
Questions to be accomplished by Issuer		YES	NO	N/A	Remarks
1. Equipment properly isolated, depressured, drained or purged					
2. All lines connected to vessel / tank properly blanked or disconnected.					
3. Equipment cleaned satisfactorily where combustible and harmful residue removed.					
4. Work in the area present possible hazard to entry.					
5. Rotating equipment tagged, locked out, tested for operation according to procedures. List name of persons holding keys.					
6. *Standby personnel with no additional duties.					
7. A gas test is required.					
8. With adequate ventilation.					
9. PPE (passed the test by OSHC)					
GAS TEST	*Ref. Value	Post Eval.	Pre. Eval	Remarks	
Carbon Monoxide PPM	50 ppm				
Hydrogen Sulfide PPM	10 ppm				
Oxygen %	16-20%				
Combustible %					
Toxic (ppm)					
Explosive % (LEL)					
PROTECTIVE EQUIPMENT REQUIRED					
NONE	Protective Gloves	Ear Protection	Stop Watch		
Dust Resp.	Life Lines	Hoisting Eq't.	Gas Monitor		
Chem. Resp.	SCBA	Others (pls. specify)			
Instructions					
I have checked the equipment and area and consider it safe for entry.					
Inspected by: _____					
Sign Over Printed Name			Position		
I have read the above permit and understand the directions.					
_____			_____		
Name of person who will enter the vessel			Signature		
<input type="checkbox"/>	Co-Employee	<input type="checkbox"/>	Contractor	_____	
				Contractor's Co. Name	
Approved by:					
_____			_____		
Dept. Supervisor's Name & Signature			Date		
List of Stand-By Personnel					

Note:

This must be returned to the supervisor at the end of the authorized entry or at the end of the work day.

*Referred to the Phil. Occupational Safety and Health Standards

REFERENCES

Environmental Health and Safety Department, Oklahoma State University.
Entering and Working in Confined Spaces.

30 January 1973, revised 31 July 1995

Pettit, Ted and Linn, Herb. *A Guide to Safety in Confined Space.* National
Institute of Occupational Safety and Health.

July 1987

Robin Anthony. *Working in Confined Space: Criteria for a Recommended
Standard.* National Institute of Occupational Safety and Health.

December 1979

Exxon Chemical Company. *Accident Prevention Manual. Bayway Chemical
Plant.*

22 September 1990

Carson, P.A. and Mumford, C. J. *The Safe Handling of Chemicals in Industry.*

Vol. 2, 1988

*The International Safety, Health and Environmental Magazine, Safety and
Health.*

Jan. 1996

Work Cover Authority of New South Wales, *Toxic Gas in Confined Space.*

ILO Encyclopedia of Occupational Health and Safety. Vol. 2, 3rd Edition
Department of Labor and Employment. *Occupational Safety and Health
Standards. TLV for Airborne Contaminants.*

1992



Prepared and adapted from NIOSH Guide to Safety
in Confined Space and Oklahoma State University
Manual on Entering and Working in
Confined Spaces to the Philippine setting by:

AVELINA M. VIADO

and the staff from

Safety Control Division

Cover and Art Work by:
Marjorie Santos