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CONFINED SPACE SAFE PRACTICE



This pamphlet has been developed using the U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health publication “A Guide to Safety in Confined Spaces”, July 1987, as a model (<http://www.cdc.gov/niosh/otherpub.html>).

Extensive revisions have been made to address situations commonly encountered by Surveyors.

It has been prepared to facilitate the safe entry into confined spaces and is intended to be used as a supplement to training programs provided to personnel.

INTRODUCTION

If you are required to carry out a Survey in a:

- boiler, pressure vessel,
- cargo, ballast, fuel oil, or lube oil tank,
- cargo hold, void space, pumphouse, or similar type enclosure,

you are working in a confined space.

How Can You Identify a Confined Space?

A confined space is a space that has any one of the following characteristics:

- ◆ Limited openings for entry and exit
- ◆ Unfavorable natural ventilation
- ◆ Not designed for continuous worker occupancy

Limited openings for entry and exit:

Confined space openings are limited primarily by size or location. Openings are usually small in size, perhaps as small as 450 mm (18 inches) in diameter, and are difficult to move through easily. Small openings may make it very difficult to get needed equipment in or out of the spaces, especially life-saving equipment when rescue is needed. However, in some cases openings may be very large, for example open-topped spaces such as ships' holds. Access to open-topped spaces may require the use of ladders, hoists, or other devices, and escape from such areas may be very difficult in emergency situations.

Unfavorable natural ventilation:

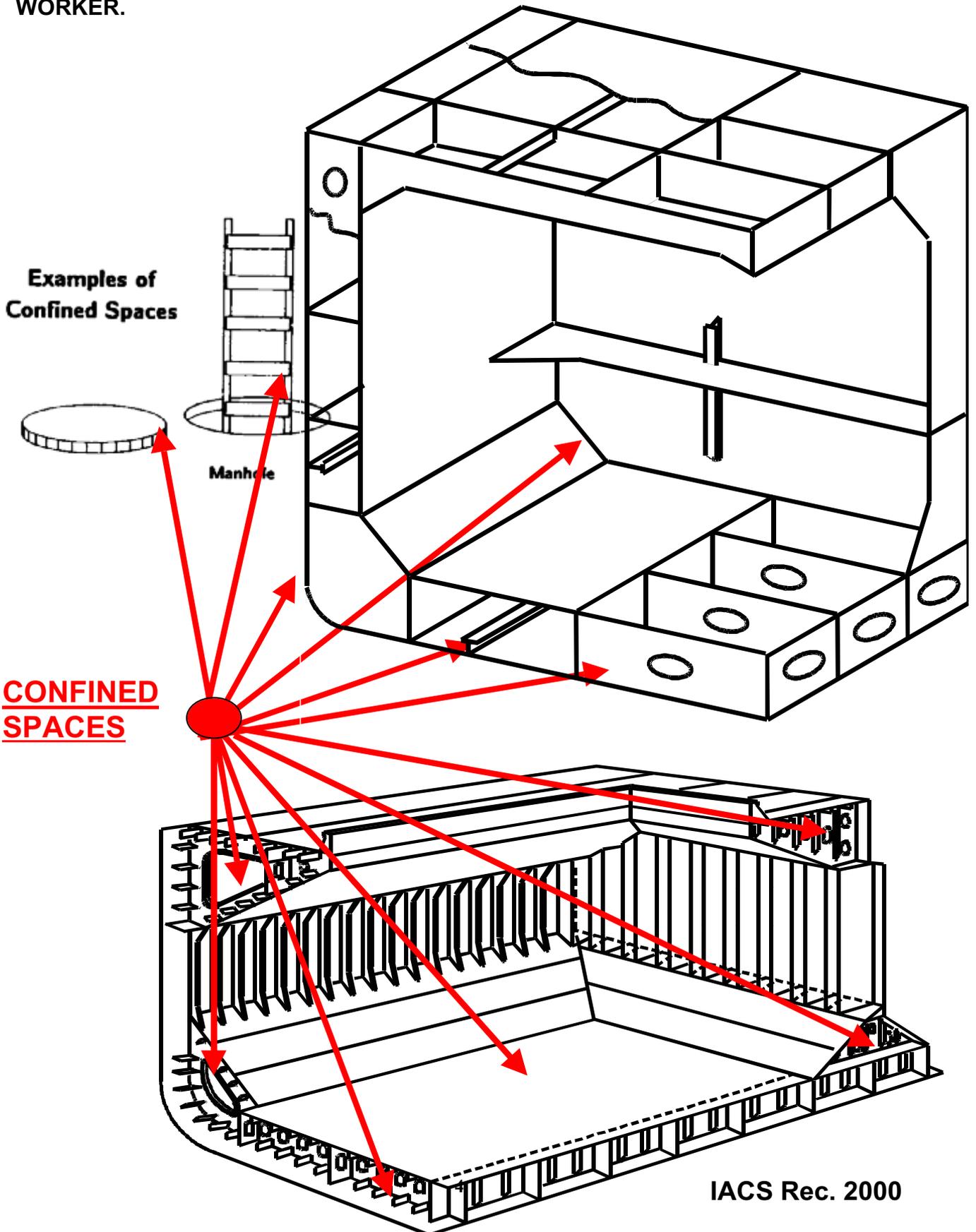
Because air may not move in and out of confined spaces freely due to the design, the atmosphere inside a confined space can be very different from the atmosphere outside. Deadly gases may be trapped inside, particularly if the space is used to store or process chemicals or organic substances which may decompose. There may not be enough oxygen inside the confined space to support life, or the air could be so oxygen-rich that it is likely to increase the chance of fire or explosion if a source of ignition is present.

Not designed for continuous worker occupancy:

Most confined spaces are not designed for workers to enter and work in them on a routine basis. They are designed to store a product, enclose materials and processes, or transport products or substances. Therefore, occasional worker entry for Survey, inspection, maintenance, repair, cleanup, or similar tasks is often difficult and dangerous due to chemical or physical hazards within the space.

A confined space found in the workplace may have a combination of these three characteristics, which can complicate working in and around these spaces as well as rescue operations during emergencies. If a Survey requires you to enter one or more work spaces with the characteristics listed above, **READ THE FOLLOWING**

INFORMATION – SOME DAY IT MAY SAVE YOUR LIFE, OR THE LIFE OF A CO-WORKER.



RECOGNITION

What are the Hazards Involved in Entering and Working in Confined Spaces?

Hazardous Atmospheres

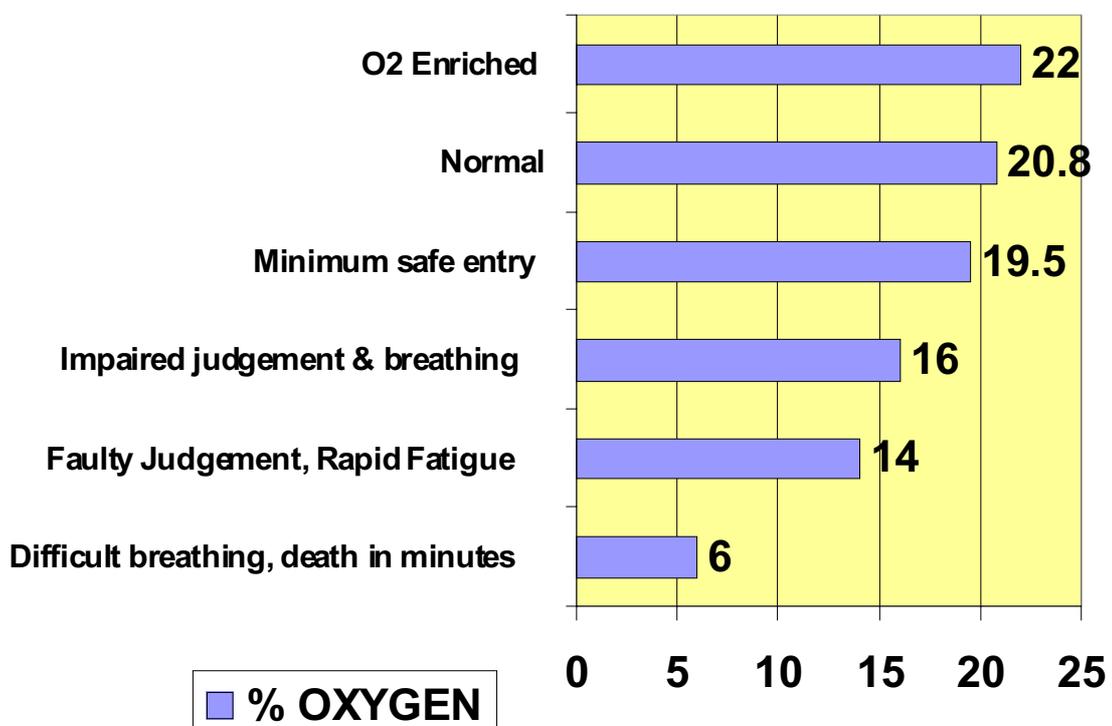
As mentioned, the atmosphere in a confined space may be extremely hazardous because of the lack of natural air movement. This characteristic of confined spaces can result in 1) oxygen-deficient atmospheres, 2) flammable atmospheres, and/or 3) toxic atmospheres.

1. OXYGEN-DEFICIENT ATMOSPHERES:

An oxygen-deficient atmosphere has less than 19.5% available oxygen (O₂). Any atmosphere with less than 19.5% oxygen should not be entered!

The oxygen level in a confined space can decrease because of work being done, such as welding, cutting, or brazing; or, it can be decreased by certain chemical reactions (rusting, paint drying) or through bacterial action (fermentation).

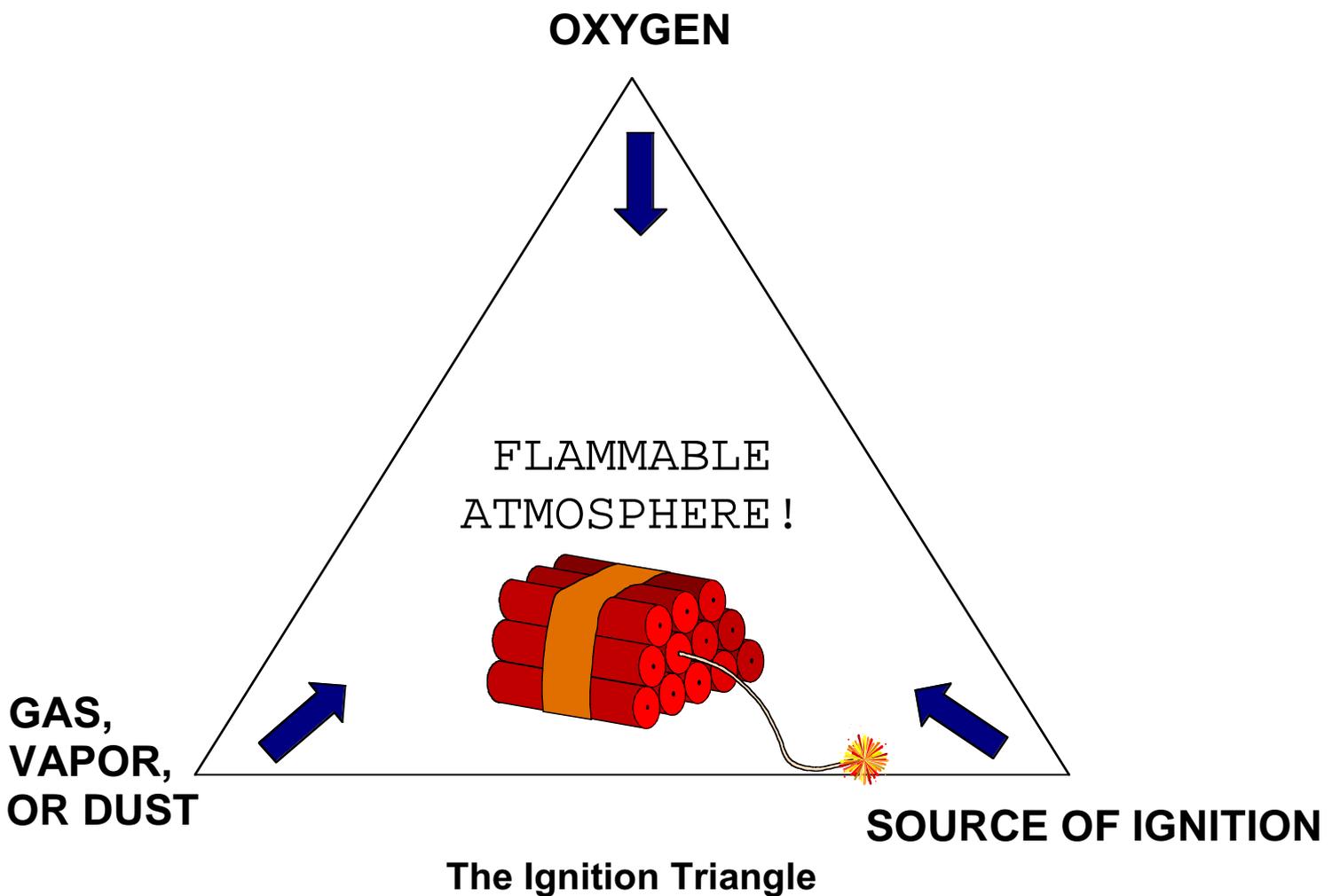
The oxygen level is also decreased if oxygen is displaced by another gas, such as carbon dioxide or nitrogen, resulting from inerting or fire suppression. Total displacement of oxygen by another gas, such as carbon dioxide, will result in unconsciousness, followed by death.



FLAMMABLE ATMOSPHERES

Two things make an atmosphere flammable: 1) the oxygen in air, and 2) a flammable gas, vapor, or dust in the proper mixture. Different gases have different flammable ranges. If a source of ignition (e.g., a sparking or electrical tool, static electricity, sand blasting) is introduced into a space containing a flammable atmosphere, an explosion will result.

An oxygen-enriched atmosphere (above 22%) will cause flammable materials, such as clothing and hair, to burn violently when ignited. Therefore, never use pure oxygen to ventilate a confined space. Ventilate with normal air.



TOXIC ATMOSPHERES

Unless a Chemist has certified a space as Safe, assume that any substance (liquids, vapors, gases, mists, solid materials, and dusts) in a confined space can be hazardous. Toxic substances may range from fast acting poisons to long term cancer causing carcinogens. Toxic substances can come from the following:

- *The product stored in the space:*

The product can be absorbed into the structure and give off toxic gases when removed or when cleaning out the residue of a stored product, toxic gases can be given off. Example: Removal of sludge or mud from a tank – decomposed material can give off deadly hydrogen sulfide gas.

- *The work being performed in a confined space:*

Examples of such include welding, cutting, brazing, painting, scraping, sand blasting, degreasing, etc. Toxic atmospheres are generated in various processes. For example, cleaning solvents are used in many industries for cleaning/degreasing. The vapors from these solvents are very toxic in a confined space.

- *Areas adjacent to the confined space:*

Toxicants produced by work in the area of the confined spaces can enter and accumulate in confined spaces.



EVALUATION

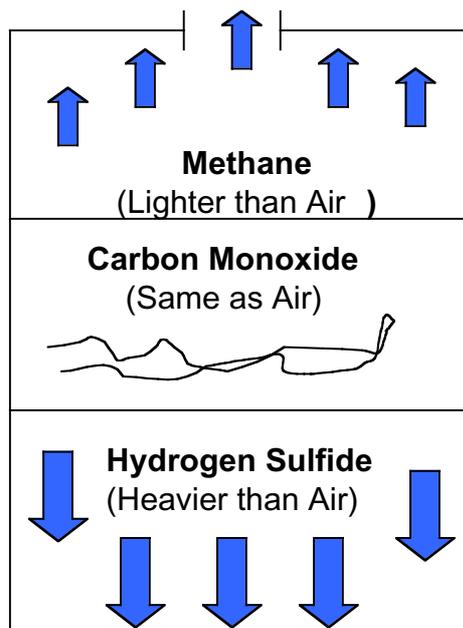
TESTING THE ATMOSPHERE

Initial testing should be done by a certified Marine Chemist, Competent Analyst or similar accredited person who will issue a certificate stating whether the space is Safe for Men and/or work and any special conditions to be observed. A person designated as “Competent” by the facility or vessel management may (if permitted by the certifying tester) do subsequent maintenance testing.

It is important to understand that some gases or vapors are heavier than air and will settle to the bottom of a confined space. Also, some gases are lighter than air and will be found around the top of the confined space. Therefore, it is necessary to test all areas (top, middle, bottom) of a confined space with properly calibrated testing instruments to determine what gases are present. Atmospheres may be different in individual bays of the same tank. If testing reveals oxygen-deficiency, or the presence of toxic gases or vapors, the space must be ventilated and re-tested before workers enter. If ventilation is not possible and entry is necessary (for emergency rescue, for example), workers must have appropriate respiratory protection.

NEVER TRUST YOUR SENSES TO DETERMINE IF THE AIR IN A CONFINED SPACE IS SAFE! YOU CAN NOT SEE OR SMELL MANY TOXIC GASES AND VAPORS, NOR CAN YOU DETERMINE THE LEVEL OF OXYGEN PRESENT.

Here are some things to note when observing a chemist or competent person.



Testing instruments for Oxygen and Flammability read in Percent. The Oxygen Meter should indicate 20.8 % Oxygen in the space being tested. The Flammability indicator shows the percent within a safety range of 0-10% of the Lower Explosive Limit (LEL) and, ideally, should read 0%.

Toxins are measured in parts per million (PPM) usually in a glass tube that changes color to indicate the PPM content of the space. A different type of tube must be used for each toxin suspected to be present.

Testing instruments are available in several different forms, hand powered by squeezing a rubber bulb or bellows, and battery powered giving the indication either on an analog gauge or digital readout.

Testing instruments must be calibrated frequently to assure accuracy.

CONTROL

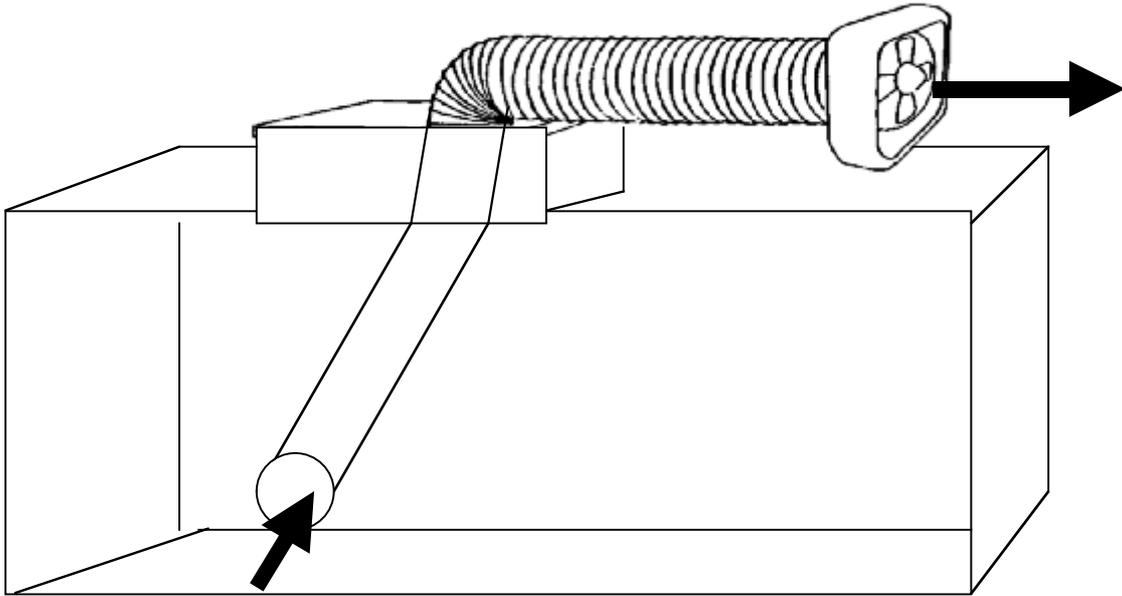
VENTILATION

Ventilation by a blower, eductor or fan may be necessary to remove harmful gases and vapors from a confined space. There are several methods for ventilating a confined space. The method and equipment chosen are dependent upon the size of the confined space openings, the gases to be exhausted (e.g., are they flammable?), and the source of makeup air.

Under certain conditions where flammable gases or vapors have displaced the oxygen level, but are too rich to burn, forced air ventilation may dilute them until they are within the explosive range. Also, if inert gases (e.g. carbon dioxide, nitrogen) are used in the confined space, the space should be well ventilated and re-tested before a worker may enter.

A common method of ventilation requires a large hose, one end attached to a fan and the other lowered into a manhole or opening. For example, a manhole would have the ventilating hose run to the bottom (see diagram) to exhaust all harmful gases and vapors. An air intake should be placed in an area that will draw in fresh air only. Ventilation should be continuous where possible, because in many confined spaces the hazardous atmosphere will form again when the flow of air is stopped.

De-ballasting a tank does not guarantee a safe atmosphere. Testing is still required.



STANDBY/RESCUE

A standby person should be assigned to remain on the outside of the confined space and be in constant contact (visual or speech) with the workers inside. The standby person should not have any other duties but to serve as standby and know who should be notified in case of emergency. Standby personnel should not enter a confined space until help arrives, and then only with proper protective equipment, life lines, and respirators.

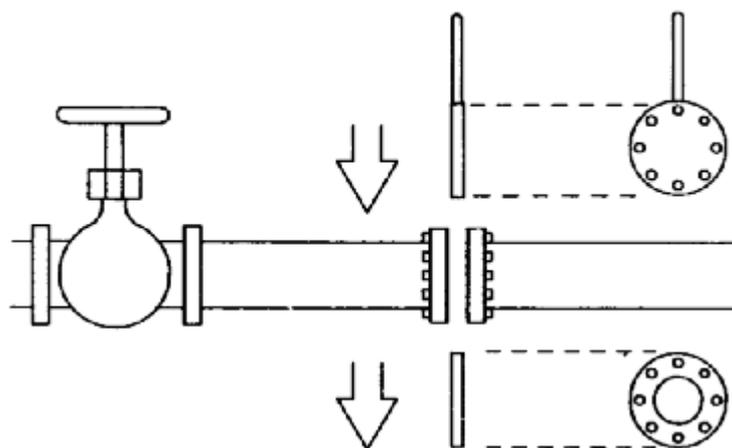
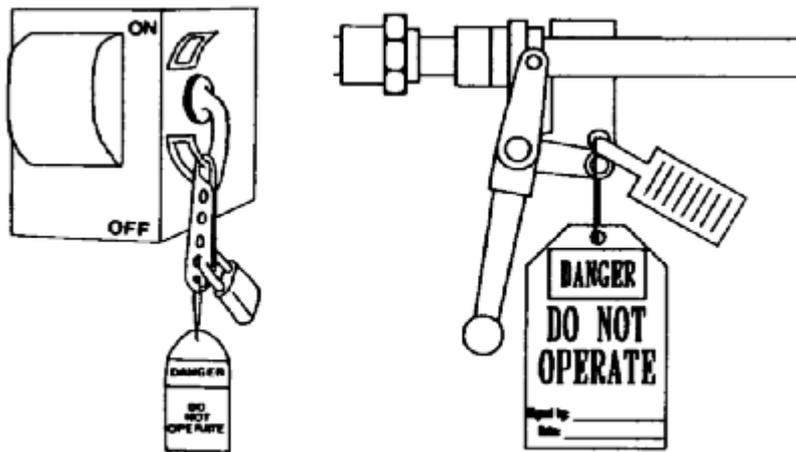
Over 50% of the workers who die in confined spaces are attempting to rescue other workers. Rescuers must be trained in and follow established emergency procedures and use appropriate equipment and techniques (lifelines, respiratory protection, standby persons, etc.). Steps for safe rescue should be included in all confined space entry procedures. Rescue should be well planned and drills should be frequently conducted on emergency procedures. Unplanned rescue, such as when someone instinctively rushes in to help a downed co-worker, can easily result in a double fatality, or even multiple fatalities if there are more than one would-be rescuers.

REMEMBER AN UNPLANNED RESCUE WILL PROBABLY BE YOUR LAST!

ISOLATION

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

- *locking out electrical sources, preferably at disconnect switches remote from the equipment.*
- *blanking and bleeding, securing valves
Cargo, ballast, IGS, pneumatic and hydraulic lines*
- *disconnecting mechanical linkages on shaft-driven equipment where possible, and*
- *securing mechanical moving parts within confined spaces with latches, chains, chocks, blocks, or other devices.*



GENERAL/PHYSICAL HAZARDS

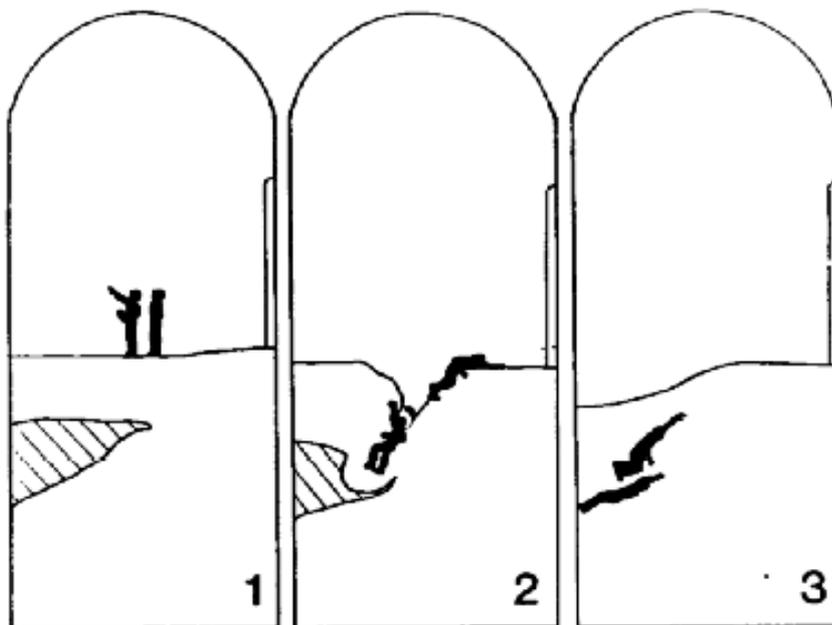
In addition to the areas discussed above, evaluation of a confined space should consider the following potential hazards:

1. TEMPERATURE EXTREMES

Extremely hot or cold temperatures can present problems for workers. For example, if the space has been steamed, it should be allowed to cool before any entry is made.

2. ENGULFMENT HAZARDS

Loose, granular material stored in holds or tanks, such as grain, sand, coal, or similar material, can engulf and suffocate a worker. The loose material can crust or bridge over and break loose under the weight of a worker.



The Hazard of Engulfment in Unstable Material

3. NOISE

Noise within a confined space can be amplified by the design and acoustic properties of the space. Excessive noise can not only damage hearing, but can also affect communication, such as causing a shouted warning to go unheard.

4. SLICK/WET SURFACES

Slips and falls can occur on a wet surface causing injury or death to workers. Also, a wet surface will increase the likelihood for and effect of electric shock in areas where electrical circuits, equipment, and tools are used.

5. FALLING OBJECTS

Workers in confined spaces should be mindful of the possibility of falling objects, particularly in space which have topside opening for entry, and where work is being done above the worker.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE is traditionally regarded as the last line of protection with the emphasis being place on avoidance and appropriate managerial control methods. However, the potentially hazardous nature and isolated position of those entering a confined space means that, for the surveyor, PPE may be the first line of protection. Each confined space will present different hazards and degrees of risk to health and safety, the final provision of PPE should therefore be based on an assessment of risk. As a general rule the following guidance is offered.

Basic surveyor PPE should include:

- Body protection (hard wearing overalls with suitable pockets for notebook etc).
- Foot protection (steel toecaps (200 joules), steel midsoles, good grip, oil resistant).
- Head protection (hard hat with chinstrap).
- Hand protection (hard wearing gloves).
- Eye protection (protective glasses, goggles).
- Ear protection (ear defenders or ear plugs - worn subject to communication system).
- Lighting (hand held torch with lanyard and appropriate beam width).

Policies for Surveyors

@ You have the right to refuse to enter an unsafe/unsure space.

If you are not confident that a space is safe for you, you should report your concerns and not enter until all safety requirements are met.

Only enter a confined space if you consider it is safe to do so, and then, only remain in the inside for as long as is necessary for you to carry out your work.

@ You will not enter a space that requires use of a respirator.

You may wear a respirator or escape pack if required by a client's policy, BUT the space MUST be safe first.

It is the responsibility of the Owner to make the space safe for the Surveyor, not to make the Surveyor safe for the space.

@ Do not enter a space first or alone!

@ IF IN DOUBT - DO NOT ENTER - NO SURVEY IS WORTH YOUR LIFE OR HEALTH.

RECOMMENDATIONS FOR SAFE ENTRY:

Consider the following questions to evaluate the confined space.

DO NOT ENTER A CONFINED SPACE UNTIL YOU HAVE CONSIDERED EVERY QUESTION AS WELL AS ANY OTHER ITEM OF CONCERN, AND HAVE DETERMINED THE SPACE TO BE SAFE.

THE FINAL DECISION IS YOURS

YES NO

- | | | |
|---|---|--|
| ☐ | ☐ | Is entry necessary? |
| ☐ | ☐ | Will someone accompany you into the space? |

TESTING

- | | | |
|---|---|---|
| ☐ | ☐ | Are the instruments used in atmospheric testing properly calibrated? |
| ☐ | ☐ | Was the person performing the tests a certified Marine Chemist, Competent Analyst, or equal, or a (competent) person designated by the facility or vessel management to so? |
| ☐ | ☐ | Was the atmosphere in the confined space tested? |
| ☐ | ☐ | Was Oxygen at least 19.5% - not more than 21%? |
| ☐ | ☐ | Were toxic, flammable, or oxygen-displacing gases/vapors present?
- Hydrogen sulfide
- Carbon monoxide
- Methane
-Carbon dioxide
Other (list) _____
_____ |

MONITORING

- | | | |
|---|---|---|
| ☐ | ☐ | Will the atmosphere in the space be monitored while work is going on? |
|---|---|---|

Remember – atmospheric changes occur due to the work procedure or the product stored and vessel movements and temperature changes. The atmosphere may change

very quickly.

YES **NO**

VENTILATION

- ☐ ☐ Has the space been ventilated before entry?
- ☐ ☐ Will ventilation be continued during entry?
- ☐ ☐ Is the air intake for the ventilation system located in an area that is free of combustible dusts and vapors and toxic substances?
- ☐ ☐ If atmosphere was found unacceptable and then ventilated, was it re-tested before entry?

ISOLATION

- ☐ ☐ Has the space been isolated from other systems?
- ☐ ☐ Has electrical equipment been locked out?
- ☐ ☐ Have disconnects been used where possible?
- ☐ ☐ Has mechanical equipment been blocked, chocked, and disengaged where necessary?
- ☐ ☐ Have lines under pressure been blanked and bled?

CLOTHING/EQUIPMENT

- ☐ ☐ Is special clothing required (boots, chemical suits, glasses, etc.)?
- ☐ ☐ Is special equipment required (e.g., rescue equipment, communications equipment, heavy duty raft, life vests, etc.)?
- ☐ ☐ Are special tools required (e.g., spark proof, intrinsically safe)?

YES **NO**

TRAINING

☐ ☐ Have you been trained in confined space entry and do you know what to look for?

STANDBY/RESCUE

☐ ☐ Will there be a standby person on the outside in constant visual or auditory communication with the person on the inside?

☐ ☐ Will the standby person be able to see and/or hear the person inside at all times?

PERMIT

(The permit is an authorization in usually writing that states that the space has been tested by a qualified person, that the space is safe for entry; what precautions, equipment, etc. are required; and what work is to be done.)

☐ ☐ Has a confined space entry permit been issued?

☐ ☐ Is the permit up to date?