Confined Spaces – Definitions, Regulations and Statistics

Description

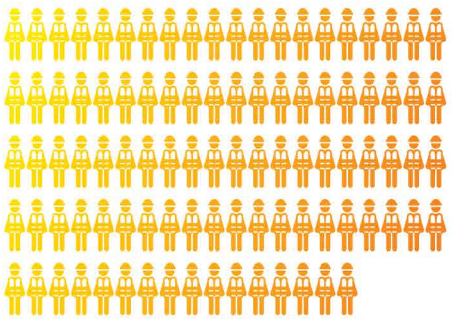
Confined spaces may present hazardous physical and atmospheric working conditions. It is the responsibility of the employer to ensure these hazards are recognized and mitigated prior to work being conducted within the confined space, and in compliance with relevant local or national regulations.

Scale of the problem – injuries and fatalities within Confined Spaces

Accurate and up to date statistics on near misses, injuries and fatalities in confined space are difficult, if not impossible to find.

In the US, confined space fatalities only are recorded. However, changes in definitions, industries or activities within scope mean that statistics can be problematic to analyse. European countries do not classify injuries or fatalities by confined space in their reporting statistics. Statistics from a US study looking at fatalities, causes and victims between 2005 and 2009 is oft quoted and helps to give a sense of the scale of the problem.

What limited data is available does support one clear conclusion: every year many people die or are seriously injured entering and working within confined spaces, with many incidents resulting in multiple fatalities, including would-be rescuers.



Deaths occur each year – 96 in the USA alone

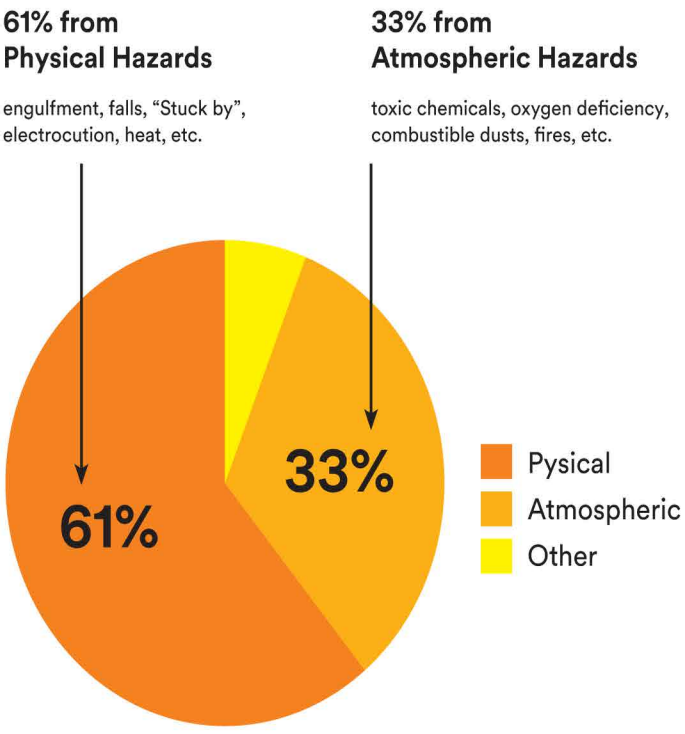
(averaged per year, based upon data from OSHA for years 2005-2009)

Sources:
https://www.rocorescue.com/roco-rescue-blog/confined-space-fatalities-a-closer-look-at-the-numbers#.XKkuxFMzbOQ

Figure 1 – Number of confined space fatalities in the USA (2005-2009)

IMPORTANT NOTE

This document is only a summary of some regulations that may be applicable in the Europe, Middle East and Africa region. The regulation landscape is summarised, but the reader is strongly encouraged to review and understand all relevant local or national regulations applicable in the country of operations prior to attempting any confined space entry. The introduction or preamble to most regulations, as well as the web pages of issuing national regulators are additional sources of information that should be consulted to help ensure a complete understanding of relevant regulations.

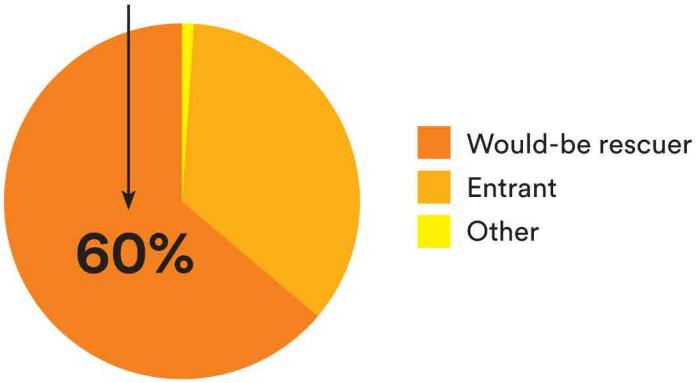


Sources:
https://www.rocorescue.com/roco-rescue-blog/confined-space-fatalities-a-closer-look-at-the-numbers#.XKkuxFMzbOQ

Figure 2 - Main causes of confined space fatalities in the USA (2005-2009)

In multi-fatality incidents reviewed, 60% of deaths are would-be rescuers:

- More people die attempting to rescue others than afflicted entrants



Sources:
https://www.ohsonline.com/articles/2018/08/01/we-must-change-the-statistics-of-confined-space-injuries-and-fatalities.aspx

Figure 3 – Fatalities of 'would-be rescuers' (2005-2009)

General Definition of Confined Spaces

A review of different workplace confined space programs and applicable regulations finds that throughout the diverse regions of the world confined space are not all defined in the exact same fashion. Despite the differences in wording, there are commonalities to most of the various definitions for confined spaces.

Generally speaking, a confined space is a partially or fully enclosed space which contains the following five characteristics:

Characteristic #1 – Is large enough and configured such that a person can bodily enter & perform work.

In order for this space to present a danger to a person, it must be big enough to allow the person to enter fully or partially into the space. For example, the fuel tanks located in the wings of a passenger aircraft are large enough to permit a worker to partially enter the space, but in some cases are not large enough to allow a complete entry due to the instrumentation within the tank.

Characteristic #2 – Has limited or impeded openings for entry and exit

This is generally taken to mean that there are only one or two ways in and out of the area, or that getting in and out is unusually difficult. For example, entering a vessel through a hatch may require squeezing or crawling through a tight space or small opening.

Characteristic #3 – Is not designed for continuous human occupancy.

If a space was never designed for people to work inside of it for long periods of time, it might not possess the conditions necessary to support human life. For example, a worker could enter and remain within a well-ventilated sewer system for several hours safely, but the sewer system is not designed to support human life for several consecutive weeks of occupancy.

Characteristic #4 – The provision of emergency response services is compromised.

This describes spaces in which the internal configuration of that space could impede or delay the provision of first aid and rescue services. For example, a worker rendered unconscious inside of an air duct system may require a complex and lengthy rescue system to be extracted from the maze-like structure before first aid can be administered.

Characteristic #5 – Contains a hazard which may pose an illness or injury.

This relates to spaces which have a hazard, or may have a hazard introduced, based on its location, design, construction, contents or atmosphere. These hazards may also be caused by materials or substances present in the space before entry or by ones brought into the space by a worker completing a task. For example, the sparks generated from grinding work completed within a vessel can cause an explosion if an oxygen-enriched atmosphere exists within the vessel.

It is worth noting that a space can become confined space due to the task being performed within it and the creation of a new or temporary hazard. For example, a space which is enclosed but is otherwise not normally classified as a confined space can become a confined space when solvent cleaning chemicals, welding or other hot-work or spray-painting work is undertaken inside.

Intentional or unintentional environmental changes can affect the classification of some spaces, changing them into confined spaces. For example, heavy rain can lead to flooding of basements or tunnels. Perishable goods or flammable materials may be stored with an inert atmosphere that presents an atmospheric hazard.

National Definitions of Confined Spaces

The differences in national regulations can present a challenge for multi-national companies seeking to comply with all applicable regulations. Many of the published articles, journal papers, text books and manuals on confined space were published in North America, and this can also lead to confusion over definitions and terminology. Although there is general commonality, there are clear technical differences between some countries in terms of definitions and in regulatory requirements. Multi-national companies therefore may need to create their own corporate policies that ensure commonality and local compliance across all their sites.

United Kingdom & Republic of Ireland

Both the UK and Republic of Ireland have specific confined space regulations, and the two are very similar in terms of definitions, scope and approach. The UK HSE Confined Space Regulations 1997 - HSE Approved Code of Practice and guidance and the Irish H&SA Code of Practice for Working in Confined Spaces define confined spaces in similar terms as being:

1. A space that is substantially (though not always entirely) enclosed, and
2. Contains one or more of the specified risks must be present or reasonably foreseeable.

    - fire or explosion (gas, vapour, dust, excess of oxygen);
    - loss of consciousness of any person at work arising from an increase in body temperature;
    - loss of consciousness or asphyxiation of any person at work arising from gas, fume, vapour or the lack of oxygen;
    - drowning due to the level of a liquid; or
    - asphyxiation from entrapment by a free flowing solid;

It is worth noting that in both the UK and Ireland, the specified risks detailed in the regulatory definitionscover the most common risks across industrial confined spaces. However, the regulations in both the UK and Ireland both recognise that this list is not exhaustive as many other serious hazards are commonly found in confined spaces, including:

- Biological risks typically from decaying organic materials or the presence of vermin
- Physical risks not covered above, including electricity, mechanical equipment, radiation, stored energy, cold temperatures, vibration, noise, air of fluid pressure
- Configuration risks from the design, shape or dimensions of the space that may limit safe access into, movement within, egress from the space.

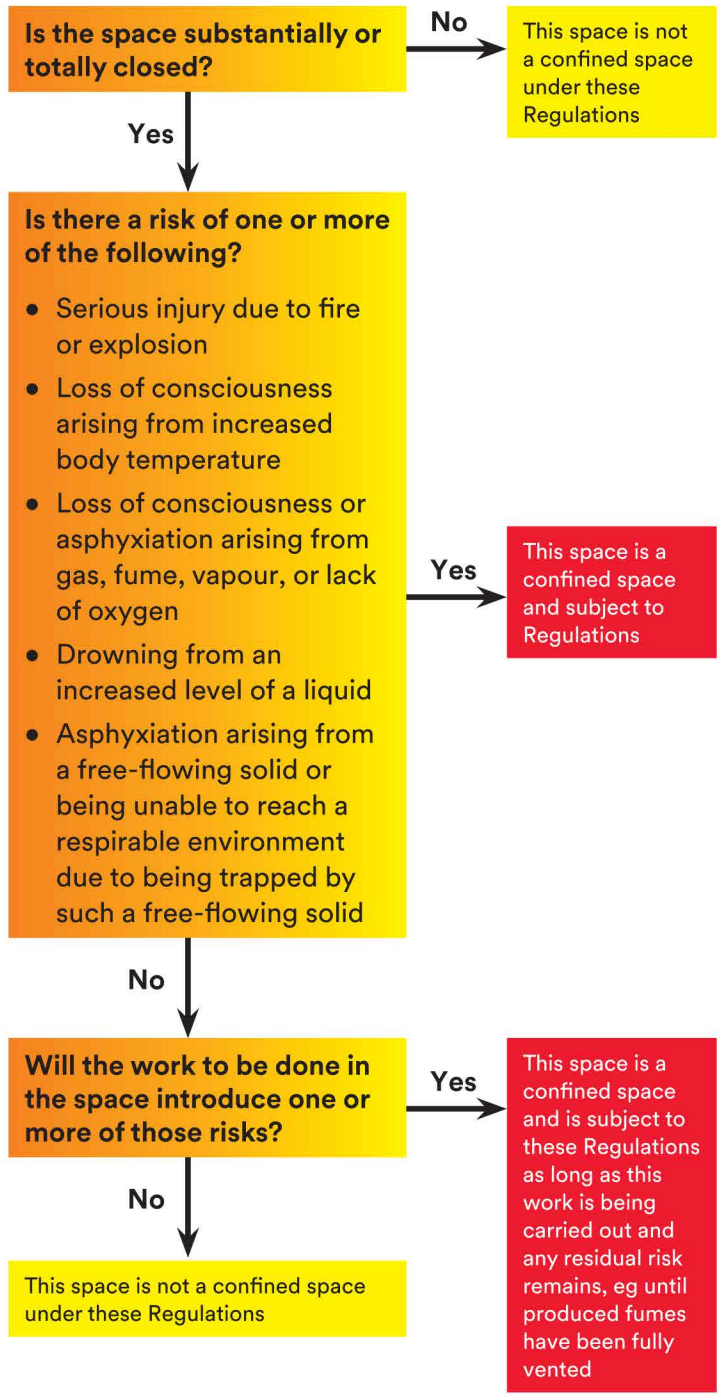


Figure 4 - "Is the area a confined space?"
(Reproduced from UK Health & Safety Executive (HSE) Confined Spaces Regulations 1997 - Approved Code of Practice and guidance - L101, third edition, published 2014)

Germany

According to the Deutsche Gestzliche Unfallversicherung (DGUV) Regel 113-004 Behälter, Silos und enge Räume - Teil 1: Arbeiten in Behältern, Silos und engen Räumen confined spaces in Germany are defined as being:

1. A space that is substantially (though not always entirely) enclosed with solid walls, and
2. Have little or no air exchange, and
3. Specified hazards that exist within or may arise within the space due to substances, preparations, impurities, facilities or work being undertaken.
    - Chemicals
    - Hazardous atmospheres
    - Chemical reactions
    - Oxygen deficiency
    - Oxygen enrichment
    - Hot substances or preparations
    - Biological agents
    - Fire or explosion
    - Engulfment
    - Mechanical systems, including closing or opening fixtures
    - Hot or cold components
    - Electricity and electrical equipment
    - Radiation
    - Configuration hazards such as ladders, scaffolds, baffle plates, complex structures or floor levels
    - Mental stress caused by hazards such as spatial closeness, large drops or heights, etc.

France

According the L'Institut national de recherche et de sécurité (INRS) document ED 6184 Les espace confinés – Assurer la sécurité et la protection de la santé des personnels intervenants a confined spaces in France are defined as being:

1. A totally or partially enclosed space (building, structure, equipment, installation ...) that:
2. has not been designed and constructed to be permanently occupied by or intended to be occupied by persons, but which may from time to time be temporarily occupied for performing maintenance, repair, cleaning, punctual and more or less frequent, or unscheduled operations following exceptional events,
3. and in which the atmosphere can pose risks to the health and safety of people who enter because of:
    - the design or location of the work,
    - either a lack of natural ventilation,
    - the substances, substances or fluids it contains or used therein,
    - the equipment used therein,
    - the nature of the work carried out therein.

United States

According to the Occupational Safety and Health Administration (OSHA) confined spaces in the USA are defined as:

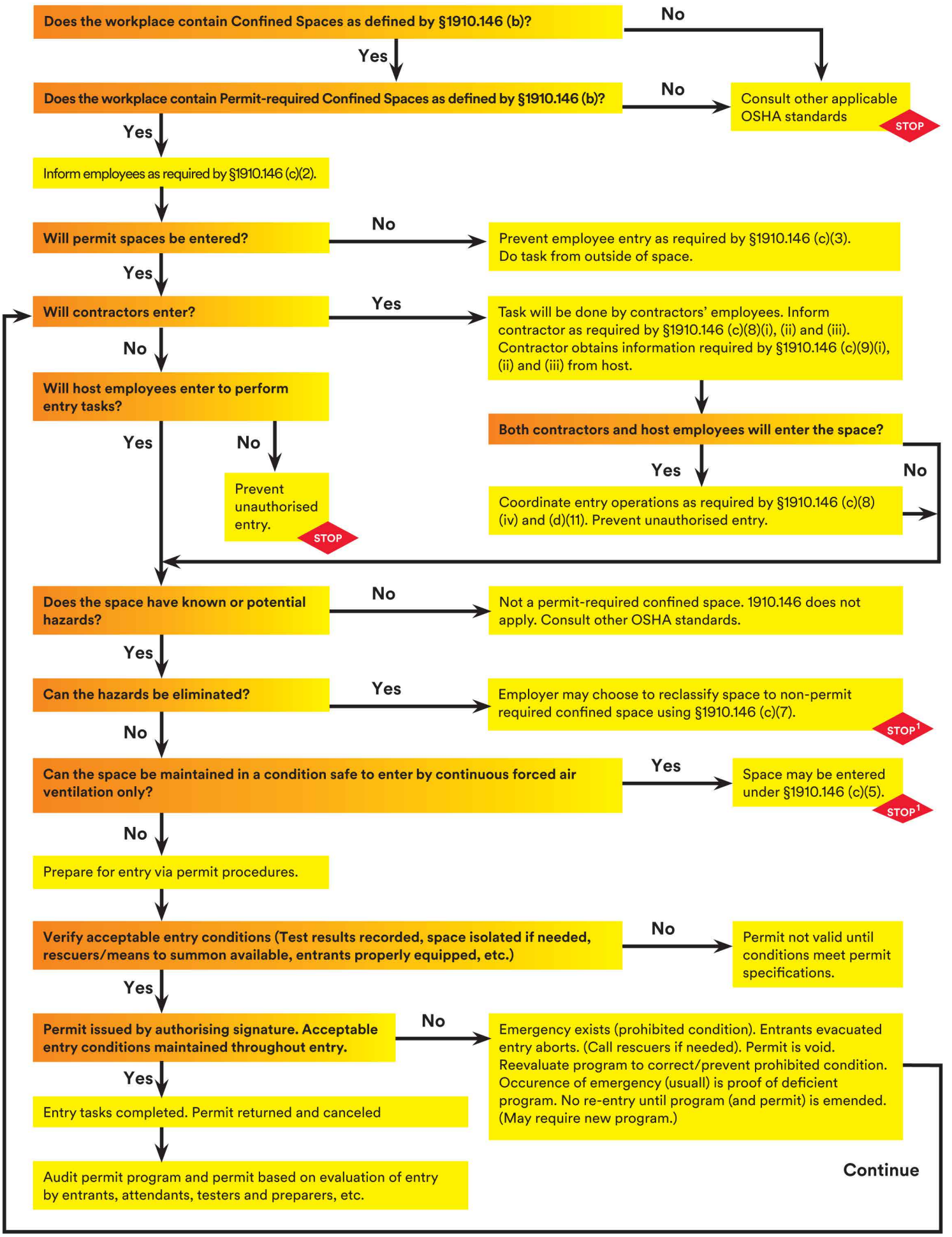
1. Is large enough and so configured that an employee can bodily enter and perform assigned work; and
2. Has limited or restricted means of entry or exit; and
3. Is not designed for continuous employee occupancy.

OSHA also uses the term "permit-required confined space" (permit space) to describe a confined space that has one or more of the following characteristics:

- contains or has the potential to contain a hazardous atmosphere;
- contains material that has the potential to engulf an entrant;
- has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant;
- or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress.

Figure 5 Permit Required Confined Spaces

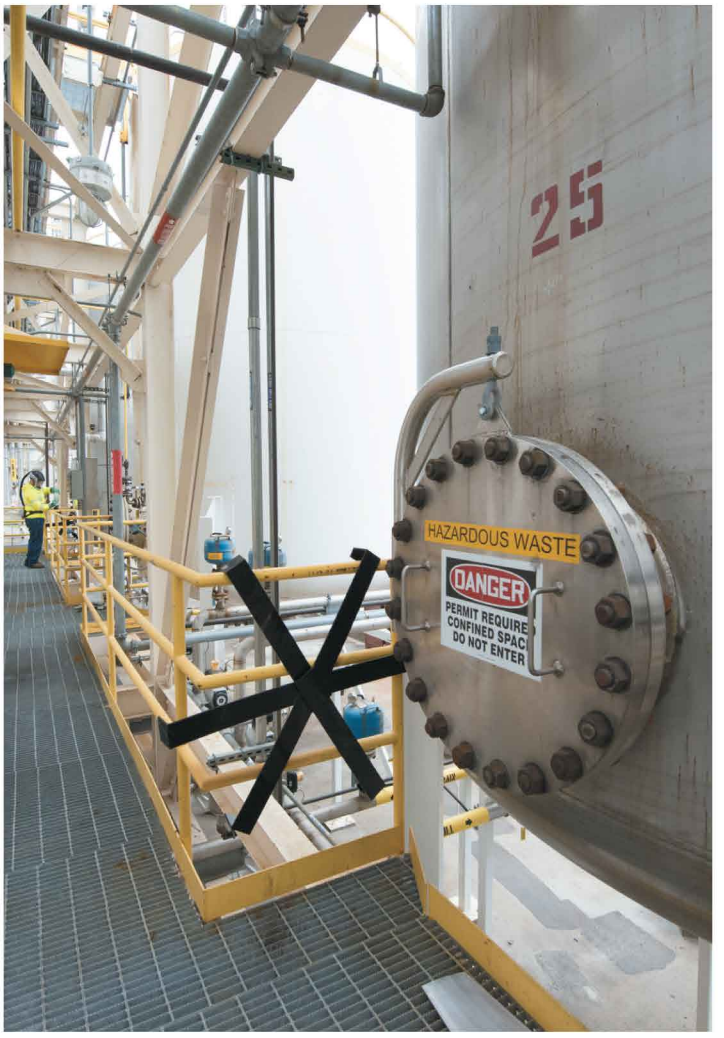
(Reproduced from US Occupational Safety and Health Administration (OSHA) Appendix A to §1910.146 -- Permit-Required Confined Space Decision Flow Chart) https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.146AppA



[1] Space may have to be evacuated and re-evaluated if hazards arise during entry

Furthermore, OSHA has published two confined space standards:

- The scope of 29 CFR 1910.146 includes all general industry. It does not apply to construction, agriculture or shipyard.
- The scope of 29 CFR 1926.1200-1213 applies to all of construction, except for certain excavations, underground works and diving. This standard also has five differences from the standard for general industry:
  1. Requires more detailed provisions with regards to coordinated activities when there are multiple employers at the worksite to ensure hazards are not introduced into a confined space by workers performing tasks outside the space.
  2. Requires a competent person to evaluate the work site and identify confined spaces, including permit spaces.
  3. Requires continuous atmospheric monitoring, whenever possible.
  4. Requires continuous monitoring of engulfment hazards.
  5. Allows for the suspension of a permit, instead of cancellation, in the event of changes from the entry conditions listed on the permit or an unexpected event.



Common Types of Confined Spaces

Introduction

Confined spaces can be complicated and anyone, in any industry, can be exposed to working in and around them. Confined spaces should be considered as some of the most dangerous hazards at the workplace. The potentially fatal consequences of entering a confined space cannot be overstated. Simply put, working within a confined space can be very dangerous. Even common tasks, such as performing routine inspections, can be potentially fatal if the proper precautions are not taken.

Confined spaces come in different sizes, in different locations of a facility or job site, some may be obvious and others less so, and there may be different hazards in each one.

As with any workplace hazard, confined spaces need to be treated with a high level of respect in order for workers to remain safe. It is easy for workers at a job site to become complacent about this hazard if not all these locations are identified. Therefore, the first step in this process is to understand what constitutes a confined space, then identify confined spaces within the workplace.

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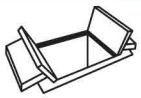
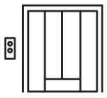
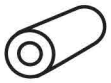
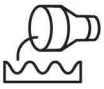
Examples of Confined Spaces

The following are examples of confined spaces that are found commonly in many industries. This a guide only. These examples should not be used as a the only means of identifying and risk assessing confined spaces in the workplace. This list is not exhaustive. Specific country legislation must be followed during the evaluation, planning and access of a confined space. The evaluation and assessment of confined spaces should be made only by a competent person knowledgeable and experienced with confined spaces.

Types of Confined Space		Frequency of Entrance (# of on-site spaces and entrance frequency)	Complexity	Number of spaces	Common vs Industry Specific Variation
	Utility Vault, Sub-cellars and Inspection Chambers	Monthly	Easy	Many	Common
	Manhole	Monthly	Easy	Many	Common
	Elevator Pit/Shaft	Annual	Moderate	Several	Common
	HVAC Duct Work	Annual	Complex	Many	Common
	Storage Tank	Annual	Complex	Many	Industry Specific
	Reaction Vessels	Monthly	Complex	Many	Industry Specific
	Trench Box	Quarterly	Easy	Several	Industry Specific
	Culverts	Monthly	Moderate	Several	Common
	Tunnels	Quarterly	Complex	Several	Common
	Waste Water Treatment	Daily	Moderate	Few	Industry Specific
	Alkylation unit	Annual	Very Complex	Many	Industry Specific

Confined Spaces – Where are they found?

Introduction

Confined spaces, as well as injuries and fatalities that occur within them, are not limited to one or two industries, but occur across almost all industries and workplaces – from agriculture to food and beverage, petrochemicals to construction and maintenance, water treatment and sewers to transportation and shipping.

Although you may automatically think of an oil refinery or a construction site when thinking of confined spaces, they may also exist – depending upon your national regulations – within your office building, local hospital, school, college, university, shopping centre, even within on street and in your home. If the space if partially or fully enclosed and may contain a hazard or some work within it creates a hazard to your health or safety, then the space may be classed as a confined space.

Some industrial sites typically have a high number of confined spaces, where entries cannot be avoided and need to be undertaken on regular basis. The following is not an exhaustive list of industries nor an exhaustive list of examples from within those industries highlighted.

Always ensure that whoever evaluates your site and confined spaces is competent to do so.

If you are planning a confined space entry, then always ensure that you have a safe system of work in place.

Pharmaceutical manufacturing

Overview

The pharmaceutical and biotech industries are diverse and complicated. The range of possible confined spaces is also extensive: from storage rooms to reactor vessels – the complexity of confined spaces also varies. Pharmaceutical manufacturing makes use of toxic and inert gases (particularly nitrogen resulting in oxygen deficient atmospheres), extremes of temperature, mechanical equipment, all often in confined spaces. The raw materials and finished pharmaceutical products can also have a range of health effects, with a need to reduce worker exposures as low as reasonably practicable – whether in production or during a period of Maintenance, Repair and Operations (MRO).

Due to the use of nitrogen in many of these areas, detection of oxygen depletion is particularly important.

Example confined spaces

> **Active Pharmaceutical Ingredient (API) production:** Reactor vessels

> **Biotech:** Process systems, fermentation vessels and purification systems

> **Proportioning:** Containment rooms, HVAC systems

> **Mixing & Granulation:** Large sifters, granulators and blending equipment

> **Liquid processes:** Storage and mixing tanks, filter presses

> **Tablet and pellet coating:** Mixing and coating drums

Granulator

Who enters	Employees of the host employer
Tasks performed	• Clean down, inspection • Non-routine tasks during cleaning, repair, maintenance of equipment
Frequency of entrance	Variable – weekly to annual, depends upon the task, confined space and its use
Complexity	Complex
Number of spaces	Single – many
Common vs Industry specific variation	Industry specific
Example Configuration Hazards	• Slips, trips and falls around and within the confined space • Working at height to access the confined space • Narrow entrances • Angled entrances (particularly on the top of reactor vessels) • Side entrances with then vertical access • Vertical access into a vessel with no ladder • Requirements to minimize possible damage to surfaces (ropes may be preferred to metal lines) • Minimisation of foreign objects entering the confined space and/or being dropped within the space
Example Biological and Chemical Hazards	• Infectious agents, particularly in the biotech industries (vaccines, blood products, etc.) • Active pharmaceutical ingredients • Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects.
Example Atmospheric Hazards	• **Toxic atmospheres:** Ammonia, Hydrogen chloride, Hydrogen sulfide, Ethanol, Chlorine, Freon, Nitric Oxide, Nitrogen dioxide • **Asphyxiant atmospheres:** Oxygen deficiency, Carbon dioxide, Sulfur dioxide • **Flammable / explosive atmospheres:** Volatile organic compounds, Oxygen enrichment, Hydrogen, Methane, Hydrogen sulfide, Ethanol, Nitric Oxide, explosive dusts
Example Physical Hazards	• Electricity • Mechanical equipment • Radiation • Hot surfaces • Being struck by objects • Temperature Extremes • Fluid or air pressure • Slips, trips and falls • Noise

References

https://gasdetection.3m.com/en/gas-detection-pharmaceutical (article accessed 22nd February 2019)

ILO Encyclopaedia of Occupational Health & Safety – Pharmaceutical Industry. Tait. K., http://www.iloencyclopaedia.org/part-xii/pharmaceutical-industry/item/385-pharmaceutical-industry#PHC_fig1 (article published 25th February 2011, article accessed 22nd February 2019)

Chemical manufacturing

Overview

Chemical manufacturing covers many disciplines and end products, along with many different raw materials and processes. The size and scale of the chemical industry is highly variable – from massive chemical parks manufacturing products by the ship-load to small batch quantities. The overall industry can be roughly split into several different sub-sects:

- **Petrochemical Industry**
- **Polymer Industry**
- **Inorganic Chemical Industry**
- **Fertiliser Industry**
- **Specialty Chemical Industry**
- **Fine Chemical Industry**
- **Consumer Products**
- **Pharmaceutical and Life sciences**

Although the industry is highly diverse, there is some commonality in terms of the likely hazards and the types of confined spaces that may be entered.

Example confined spaces

> Storage tanks and silos
> Columns
> Reactor vessels
> Furnaces, boilers, flues, towers and stacks
> Pipework
> Filtration units

Who enters	• Employees of the host employer • Specialist contractors
Tasks performed	• Cleaning and removal of blockages within process plant • Replacement of catalysts • MRO turnarounds – annual periods of maintenance or repair during a period of plant shut-down. Other none routine tasks are also completed, for example modifications (revamp or renewal) and cleaning. MRO turnarounds are often time-limited and expensive due to plant being taken offline, resulting in significant pressure to get the tasks completed on time. External contractors specializing in MRO turnarounds, including confined space entry, are often employed. Turnarounds can present significant management challenges.
Frequency of entrance	Typically, annual unless an urgent repair is required
Complexity	Complex
Number of spaces	Single – many
Common vs Industry specific variation	Industry specific
Example Configuration Hazards	• Slips, trips and falls around and within the confined space • Working at height to access the confined space, for example on a column, tank or silo • Narrow entrances • Angled entrances (particularly on the top of reactor vessels) • Side entrances into storage tanks, with then vertical access • Vertical access into a vessel with no ladder
Example Biological and Chemical Hazards	• Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects.
Example Atmospheric Hazards	• **Toxic atmospheres**: Ammonia, Hydrogen chloride, Hydrogen sulfide, Ethylene oxide, Chlorine, Nitric oxide, Carbon monoxide, Nitrogen dioxide • **Asphyxiant atmospheres**: Oxygen deficiency, Carbon dioxide, Sulfur dioxide, Inert gases (used extensively throughout the various chemical industries) • **Flammable / explosive atmospheres:** Volatile organic compounds, Oxygen enrichment, Hydrogen, Methane, Hydrogen sulfide, explosive dusts
Example Physical Hazards	• Electricity • Mechanical equipment, e.g. agitators and stirrers • Radiation • Hot surfaces • Being struck by objects • Temperature Extremes • Fluid or air pressure • Slips, trips and falls • Noise

References

https://gasdetection.3m.com/en/gas-detection-petrochemical (article accessed 22nd February 2019)

ILO Encyclopaedia of Occupational Health & Safety – Chemical Industry. De Boer. L., http://www.iloencyclopaedia.org/part-xii-57503/chemical-processing (article published 26th February 2011, article accessed 25th February 2019)

Food and beverage manufacturing

Overview

The food and beverage industry contains many similar confined spaces, however the industry can be divided into many different sub-groups, each has its own health and safety challenges and in some cases unique confined space hazards. In many cases though, confined spaces can be found in the storage of bulk liquid or solid raw materials or finished products, within process equipment (mixers, fermentation, ovens) or in refrigerated storage rooms.

- Meat, poultry and fish
- Milling, animal feeds
- Bakery products
- Dairy products
- Fruit and vegetables
- Confectionery
- Chilled and frozen foods
- Sugar processing and refining
- Corn milling and ethanol
- Oil and fat processing
- Supply chain
- Fruit juices
- Bottling and canning
- Coffee and tea
- Brewing, fermentation and distilling

Example confined spaces

> Mixing tanks
> Fermentation vats in brewing and wine making
> Fermenters and stills in the distilled drinks industry
> Ovens
> Boilers
> Storage tanks
> Grain bins and silos
> Sewer pits
> Machine pits / spaces around machinery
> Water treatment vessels

Who enters	• Employees of the host employer • Specialist contractors / maintenance engineers
Tasks performed	• Cleaning • Clearing blockages • Maintenance and repair
Frequency of entrance	Weekly or monthly
Complexity	Simple
Number of spaces	Single
Common vs Industry specific variation	Industry specific
Example Configuration Hazards	• Slips, trips and falls around and within the confined space • Working at height to access the confined space, for example on a column, tank or silo • Narrow entrances • Angled entrances (particularly on the top of reactor vessels) • Side entrances into storage tanks, with then vertical access • Vertical access into a vessel with no ladder
Example Biological and Chemical Hazards	• Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects, particularly cleaning and disinfection chemicals • Exposure to moulds and bacteria on grain and other crops • Exposure to animals, urine, feaces, mites/ticks, blood products, animal carcasses, decomposing materials, infectious microorganisms, vermin
Example Atmospheric Hazards	• **Toxic atmospheres:** Ammonia, Hydrogen chloride, Hydrogen sulfide, Chlorine, Ethanol, Carbon monoxide, Nitrogen dioxide, Phosphoric acid, Hydrogen peroxide • **Asphyxiant atmospheres:** Oxygen deficiency, Carbon dioxide, Sulfur dioxide, Inert gases (used extensively throughout the various chemical industries) • **Flammable / explosive atmospheres:** Volatile organic compounds, Oxygen enrichment, Hydrogen, Methane, Hydrogen sulfide, explosive dusts
Example Physical Hazards	• Engulfment in flowing solids such as grain • Drowning in liquids • Electricity • Mechanical equipment • Radiation • Hot surfaces • Being struck by objects • Temperature Extremes • Fluid or air pressure • Slips, trips and falls • Noise

References

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ILO Encyclopaedia of Occupational Health & Safety – Food Industry. Berkowitz. D.E., http://www.iloencyclopaedia.org/part-x-96841/food-industry (article published 29th March 2011, article accessed 25th February 2019)
BMPA Health and Safety Guidance for the Meat Industry. https://britishmeatindustry.org/resources/health-and-safety/ (article published 1st February 2014, article accessed 25th February 2019)
ILO Encyclopaedia of Occupational Health & Safety – Beverage Industry. Ward. L.A., http://www.iloencyclopaedia.org/part-x-96841/beverage-industry (article published 4th April 2011, article accessed 25th February 2019)

Oil and gas

Overview

The oil and gas (petroleum) industry can be divided roughly into two or three sections:

- **Upstream** – exploration, extraction and production of crude oil and natural gas
- **Midstream** – (sometimes included in downstream category) transportation of crude oil and natural gas, storage
- **Downstream** – refining of petroleum crude oil, processing and purification of natural gas, sales and marketing of finished products.

Confined spaces hazards within this industry typically are orientated around the production (cracking, distillation, refinement), transportation and storage of petroleum products, by-products and waste.

Example confined spaces

> Pipelines
> Storage and transportation tanks
> Coke (by-product) storage silos
> Distillation towers
> Reactor vessels
> Alkylation units
> Furnaces, boilers, flues, towers and stacks
> Filtration units
> Water treatment vessels

Who enters	• Employees of the host employer • Specialist contractors
Tasks performed	• Cleaning and removal of blockages within process plant • Replacement of catalysts in catalytic cracking or alkylation units • MRO turnarounds – annual periods of maintenance or repair during a period of plant shut-down. Other none routine tasks are also completed, for example modifications (revamp or renewal) and cleaning. MRO turnarounds are often time-limited and expensive due to plant being taken offline, resulting in significant pressure to get the tasks completed on time. External contractors specializing in MRO turnarounds, including confined space entry, are often employed. Turnarounds can present significant management challenges.
Frequency of entrance	Typically, annual unless an urgent repair is required
Complexity	Complex
Number of spaces	Single – many
Common vs Industry specific variation	Industry specific
Example Configuration Hazards	• Slips, trips and falls around and within the confined space • Working at height to access the confined space, for example on a column, tank or silo • Narrow entrances • Angled entrances (particularly on the top of reactor vessels) • Side entrances into storage tanks, with then vertical access • Vertical access into a vessel with no ladder
Example Biological and Chemical Hazards	• Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects. • Acid catalysts used in some petrochemical processes • Welding fume • Mercury
Example Atmospheric Hazards	• **Toxic atmospheres:** Ammonia, Hydrogen chloride, Hydrogen sulfide, Ethylene oxide, Chlorine, Nitric Oxide, Carbon monoxide, Nitrogen dioxide • **Asphyxiant atmospheres:** Oxygen deficiency, Carbon dioxide, Sulfur dioxide, Inert gases (used extensively throughout the various petrrochemical processes) • **Flammable / explosive atmospheres:** Volatile organic compounds, Oxygen enrichment, Hydrogen, Natural gas and other combustible gases, Hydrogen sulfide, explosive dusts
Example Physical Hazards	• Electricity • Mechanical equipment, e.g. agitators and stirrers • Radiation • Hot surfaces • Being struck by objects • Temperature Extremes • Fluid or air pressure • Slips, trips and falls • Noise

References

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ILO Encyclopaedia of Occupational Health & Safety – Oil and Natural Gas. Kraus. R.S., http://www.iloencyclopaedia.org/part-xii-57503/oil-and-natural-gas (article published 26th February 2011, article accessed 25th February 2019)

Water and Waste water treatment

Overview

Water treatment plants use a range of processes to remove solid, liquid and gaseous contaminants from water, including sedimentation, coagulation, flocculation, aeration, disinfection, filtration and sludge treatment.

There are a range of hazards within these process steps, including physical, microbial and chemical.

Within a water treatment facility there will be a diverse range of confined spaces that are underground, below grade vaults, manholes and sedimentation tanks. Within these spaces there are risks of oxygen deficiency, toxic atmospheres, engulfment/drowning risks and mechanical hazards from pumping / stirring equipment. Oxygen is consumed by some processes or may be displaced by toxic/asphyxiant/explosive gases such as methane and hydrogen sulphide which are created by organic decomposition.

Microbiological hazards exist throughout the waste water treatment processes, as well as chemical hazards from the various process steps.

Example confined spaces

> Manholes
> Sedimentation tanks
> Aerators
> Chlorinators
> Enclosed filtration units
> Pits
> Sumps
> Separator units
> Incinerators

Who enters	• Repair and maintenance workers
Tasks performed	• Cleaning and removal of blockages within process plant • Replacement of catalysts in catalytic cracking or alkylation units • MRO turnarounds – annual periods of maintenance or repair during a period of plant shut-down. Other none routine tasks are also completed, for example modifications (revamp or renewal) and cleaning. MRO turnarounds are often time-limited and expensive due to plant being taken offline, resulting in significant pressure to get the tasks completed on time. External contractors specializing in MRO turnarounds, including confined space entry, are often employed. Turnarounds can present significant management challenges.
Frequency of entrance	Daily
Complexity	Moderate
Number of spaces	Few
Common vs Industry specific variation	Industry Specific
Example Configuration Hazards	• Slips, trips and falls around and within the confined space • Working at height to access the confined space, for example on a column, tank or silo • Access into tanks from walkways, catwalks and over concrete walls • Narrow entrances • Angled entrances • Side entrances into storage tanks, with then vertical access • Vertical access into a vessel with no ladder
Example Biological and Chemical Hazards	• Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects. • Exposure to decomposing organic materials, human and animal waste • Vermin
Example Atmospheric Hazards	• **Toxic atmospheres:** Ammonia, Hydrogen sulfide, Chlorine, Hydrogen cyanide, Carbon monoxide, Nitrogen dioxide, Ozone • **Asphyxiant atmospheres:** Oxygen deficiency, Carbon dioxide, Sulfur dioxide, • **Flammable / explosive atmospheres:** Volatile organic compounds, Oxygen enrichment, Hydrogen, Natural gas and other combustible gases, Hydrogen sulfide, explosive dusts
Example Physical Hazards	• Drowning in water and other liquid effluents • Electricity • Mechanical equipment, e.g. agitators and stirrers • Radiation • Hot surfaces • Being struck by objects • Temperature Extremes • Fluid or air pressure • Slips, trips and falls • Noise

References

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