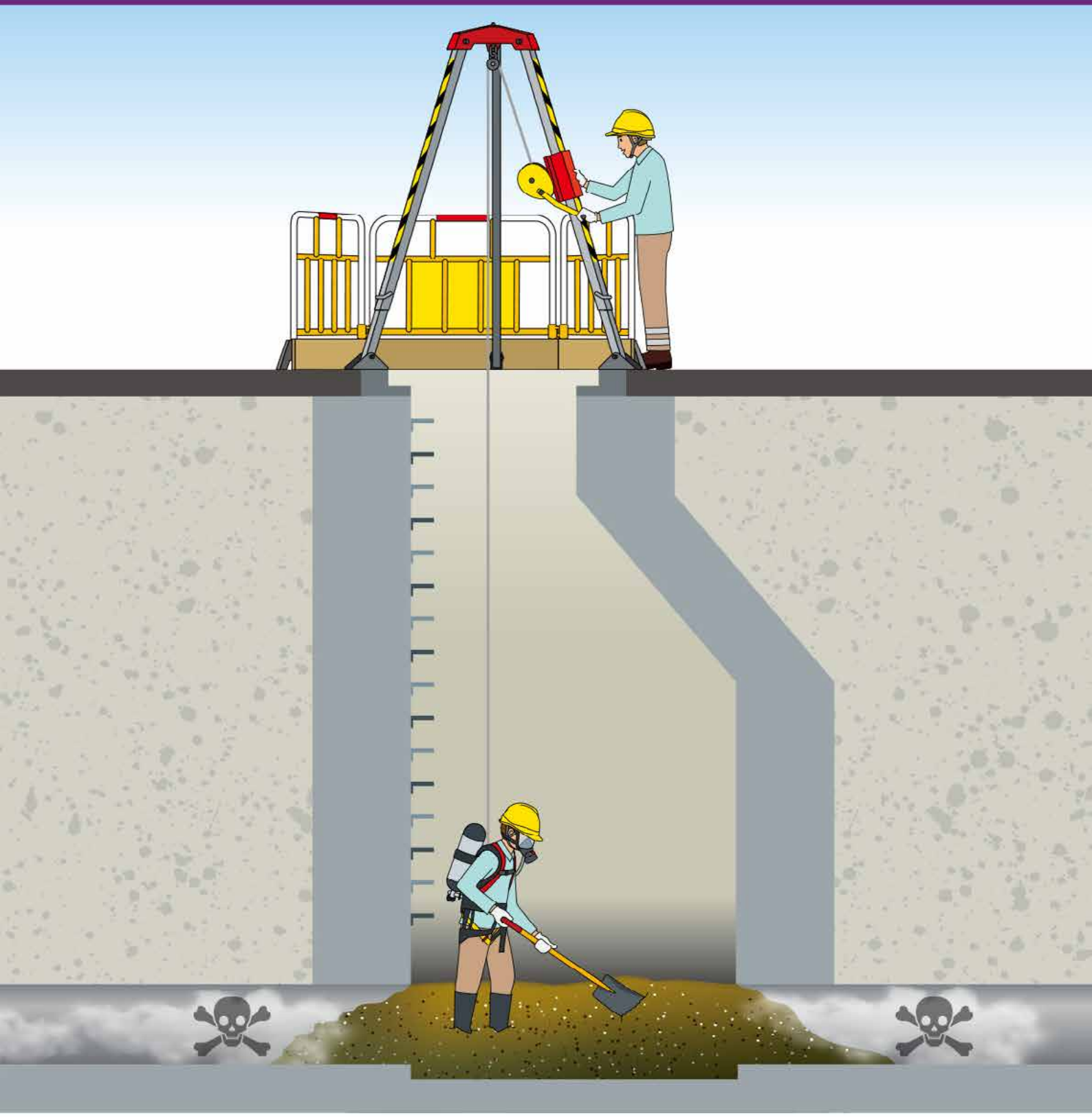
Guidance Notes on Safety and Health for Prevention of Gas Poisoning in Drainage Works



Occupational Safety and Health Branch
Labour Department

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1. Introduction

1.1 Workers engaged in drainage works, especially the works in sewers or underground pipes, may encounter various potential hazards, such as gas poisoning or even death due to inhalation of hazardous gases.

1.2 According to the Factories and Industrial Undertakings Ordinance (Cap. 59) and the Factories and Industrial Undertakings (Confined Spaces) Regulation (F&IU(CS)R) (Cap. 59AE), when drainage works are to be carried out in a confined space, the proprietor or contractor shall provide a safe system of work, including appointing a competent person to conduct a risk assessment on the working environment of drainage works in the confined space, devising a safe method statement and taking preventive and control measures based on the legislation requirements and the assessment results. For example, implementation of permit-to-work system; formulating an emergency plan; provision of necessary information, instructions, training and supervision to workers; provision of appropriate personal protective equipment and ensuring that workers use these equipment properly are the measures to safeguard workers' occupational safety and health (OSH) and avoid occurrence of accidents.

1.3 The aim of this Guidance Notes is to provide practical guidance for proprietors, contractors, employers and relevant workers to avoid workers from poisoning due to inhalation of hazardous gases when performing drainage works in confined spaces, and to enhance the OSH awareness of relevant stakeholders. Workers participating in drainage works in confined spaces and other personnel involved in the works should also read this Guidance Notes carefully to establish a comprehensive safe system of work to minimize, so far as reasonably practicable, the risk of accidents to the lowest level.

1.4 This Guidance Notes should be read in conjunction with the publications issued by the Labour Department (LD), such as "Code of Practice - Safety and Health at Work in Confined Spaces", "A Brief Guide to the F&IU(CS)R", "Safe Work in Confined Spaces", "Safety Guide for Work in Manholes", etc. Apart from these publications, reference should also be made to relevant national/international standards.

2. Scope of Application and Definitions

2.1 This Guidance Notes mainly focuses on the risk of gas poisoning or asphyxiation arising from gas, fume, vapour or lack of oxygen in relation to drainage works. It is applicable to the drainage work taken place within a confined space or taken place within the immediate vicinity of, and associated with work occurring within a confined space. The duty holders (including proprietors and contractors) carrying out other confined space work with the above risk involved shall also comply with the relevant requirements of this Guidance Notes where practicable. However, this Guidance Notes does not cover the OSH matters of all relevant work at the worksite.

2.2 This Guidance Notes adopts the following definitions:

- **"Confined space"** means any place in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk, and without limiting the generality of the foregoing, includes any chamber, tank, vat, pit, well, sewer, tunnel, pipe, flue, boiler, pressure receiver, hatch, caisson, shaft or silo in which such risk arises.

- **"Specified risk"** means a risk of -

  a) serious injury to any person at work arising from a fire or explosion;

  b) the loss of consciousness of any person at work arising from an increase in body temperature;

  c) the loss of consciousness or asphyxiation of any person at work arising from gas, fume, vapour or the lack of oxygen;

  d) the drowning of any person at work arising from an increase in the level of liquid; or

  e) the asphyxiation of any person at work arising from a free flowing solid or the inability to reach a respirable environment due to entrapment by a free flowing solid.

- **"Occupational Exposure Limit" (OEL)** refers to the airborne concentration(s) of individual chemical agents that represent levels that are regarded to impose no adverse health effects to nearly all workers on exposures by the route of inhalation. For the "Occupational Exposure Limit" for individual chemicals, please refer to the "Code of Practice on Control of Air Impurities (Chemical Substances) in the Workplace" issued by the LD.

- **"Underground pipework"** in confined space means work in a confined space, which meets the definition of a confined space in the F&IU(CS)R and the underground pipework as set out in section 9 of the Regulation. To assess whether a work is an underground pipework, factors to be considered include (1) whether the work is conducted inside a confined space; (2) whether the aforesaid confined space is underground; and (3) whether the work involves any pipes or their associated work. Typical underground pipework include (1) workers are required to enter any underground drains or their associated manholes, which have been classified as confined spaces, to carry out inspection or maintenance of drainage works, etc.; or (2) workers are required to enter any underground confined spaces for inspection or maintenance work of pipes.

- **"Atmospheric hazard"** refers to the presence of gases, vapours, dusts, fumes, mists or lack of oxygen in a confined space, which potentially cause harm to the safety or health of persons staying in the confined space.

- **"Competent person"** means a person -

  a) who has attained the age of 18 years;

  b) who is either—

     i. a safety officer registered under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations; or

     ii. a person who holds a certificate issued by a person whom the Commissioner for Labour (Commissioner) has authorized to certify persons as being competent to prepare risk assessment reports; and

  c) who has at least one year's relevant experience, after obtaining the registration or certification referred to in paragraph (b)(i) or (ii), in assessing risk to the safety and health of workers working in confined spaces.

- **"Certified worker"** means a person -

  a) who has attained the age of 18 years; and

  b) who holds a certificate issued by a person whom the Commissioner has authorized to certify workers as being competent to work in a confined space.

- **"Standby person"** means when there is a certified worker working in the confined space, another worker, namely the "standby person", shall be assigned to be stationed outside the confined space to maintain communication with the worker inside the confined space. Standby person shall have sufficient physical strength to be capable of pulling workers out of the confined space, and is responsible for contacting the emergency rescue team when necessary. It would be desirable if the "standby person" is a certified worker or competent person as defined in the F&IU(CS)R.

- **"Safety Supervisory Personnel"** means a person responsible for supervising and guiding the occupational safety and health issues related to confined space work. It would be desirable if the safety supervisory personnel is a competent person as defined in the F&IU(CS)R or a registered safety officer.

- **"Risk assessment report"** means a written report with the assessment and recommendations made by a competent person in accordance with section 5 of F&IU(CS)R.

- **"Certificate"** means the certificate issued by the proprietor or contractor responsible for the confined space work who has received a risk assessment report completed by a competent person and has verified that the risk assessment report covers all matters referred to section 5(2) of F&IU(CS)R and all necessary safety precautions have been taken before a worker enters a confined space for the first time. The permit-to-work certificate in section 6.2.1 of this Guidance Notes is considered one of the certificates.

- **"Approved breathing apparatus"** means a breathing apparatus of a type approved by the Commissioner under section 12 of F&IU(CS)R. The notice of approval of these apparatuses will be published in the Gazette and a list of approved breathing apparatuses can be found on the website of LD.

3. Legal Requirements and Responsibilities

3.1 The Factories and Industrial Undertakings Ordinance and its subsidiary regulations stipulate the legal responsibilities of the proprietors and contractors (including employers) conducting construction work at industrial undertakings, including construction, erection, installation, reconstruction, repair, maintenance, renewal, removal, alteration, improvement, dismantling, or demolition of any water, electrical, gas, telephonic, telegraphic, tunnels, etc. in respect of the safety and health of workers at work.

3.2 The Factories and Industrial Undertakings Ordinance stipulates general duties on proprietors and contractors (including employers) with regard to safety and health at work of employees at industrial undertakings, including the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health of workers, and provision of all necessary safety and health information, instructions, training and supervision.

3.3 In addition, according to the Occupational Safety and Health Ordinance and its subsidiary regulations, responsible persons (including employers) are obliged to provide or maintain a working environment that is, so far as reasonably practicable, safe and without risks to health; and ensure that the workplace is adequately ventilated by fresh air, and that, as far as reasonably practicable, the air within the workplace is kept free of impurities. Responsible person (including employers) must also take all reasonably practicable steps to protect employees employed from inhaling impurities and to prevent accumulation of the impurities at the workplace.

3.4 Every person employed at work shall comply with the general duties of person employed as stipulated under the Factories and Industrial Undertakings Ordinance, which include taking reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at work; and as regards any duty or requirement imposed on a proprietor of the industrial undertaking, contractor or any other person for securing the health and safety of person employed at the industrial undertaking, co-operating with the proprietor, contractor or other persons so far as is necessary to enable that duty or requirement to be performed or complied with.

3.5 In addition, the F&IU(CS)R stipulates responsibilities and specific duties of proprietors, contractors, competent persons and certified workers undertaking work in confined spaces including underground pipework. For details, please refer to publications including “A Brief Guide to the F&IU(CS)R”, “Code of Practice - Safety and Health at Work in Confined Spaces”, “Safe Work in Confined Spaces”, etc. published by the LD.

3.6 The F&IU(CS)R stipulates that the proprietor or contractor shall issue a certificate after he has received the risk assessment report and has verified that such report covers all matters referred to in section 5(2) of the Regulation, and also verified that recommendations in the risk assessment report and all necessary safety precautions before the commencement of the work as specified in sections 6 and 7 had been taken. The certificate shall state that all necessary safety precautions have been taken with respect to the hazards identified and the period during which workers may remain safely in the confined space. In addition, the “Code of Practice - Safety and Health at Work in Confined Spaces” recommends the use of a “permit-to-work” system to assist in following the recommendations of the risk assessment report and issuing certificates. The person authorised by the proprietor or contractor to issue the “permit-to-work certificate” should also be delegated with authority to check if the worker entering the confined space is a certified worker or not.

3.7 Section 8 of the F&IU(CS)R stipulates that the proprietor or contractor shall ensure that a person, namely the "standby person", is stationed outside the confined space to maintain communication with the workers inside, and to ensure that no workers enter or work in the confined space other than certified workers.

3.8 Section 9 of the F&IU(CS)R stipulates that where a risk assessment report recommends the use of an approved breathing apparatus, or a person has to enter a confined space for underground pipework, the person entering or remaining in that confined space shall have properly worn an approved breathing apparatus and safety hardness connected to a lifeline which is strong enough to enable him to be pulled out. The proprietor or contractor shall also ensure that the free end of the lifeline is held by a person outside the confined space who has sufficient physical strength to be capable of pulling the person out of the confined space.

3.9 Section 10 of the F&IU(CS)R stipulates that the proprietor or contractor shall formulate and implement appropriate emergency procedures to deal with any serious and imminent danger to workers inside a confined space, including the readily available rescue equipment, etc. When work is taking place in the confined space, the proprietor or contractor shall ensure that a sufficient number of persons (commensurate with the scale of the job) are present who know how to use rescue equipment and execute emergency procedures. As for the "standby person", he/she shall be responsible for maintaining communication with the workers inside the confined space. The standby person shall also have sufficient physical strength to be capable of pulling workers out of the confined space, and is responsible for contacting the emergency rescue team when necessary.

3.10 Section 11 of the F&IU(CS)R stipulates that the proprietor or contractor shall provide, to all workers working within a confined space or assisting with such work from immediately outside the confined space, such instructions, training and advice as are necessary to ensure the safety and health of all workers in the confined space. Apart from displaying the "risk assessment report" and the "permit-to-work certificate" in a conspicuous place at the entrance of the confined space, the proprietor or contractor shall do so for warning signs or notices, pointing out the specified risks in the confined space and the necessary safety precautions to be taken.

4. Common Mistakes Leading to Gas Poisoning in Drainage Works

Gas poisoning incidents in drainage works can lead to injuries and even death of many workers. This chapter lists out common mistakes leading to gas poisoning in drainage works to increase the safety awareness of duty holders.

4.1 Inadequate Safety Awareness

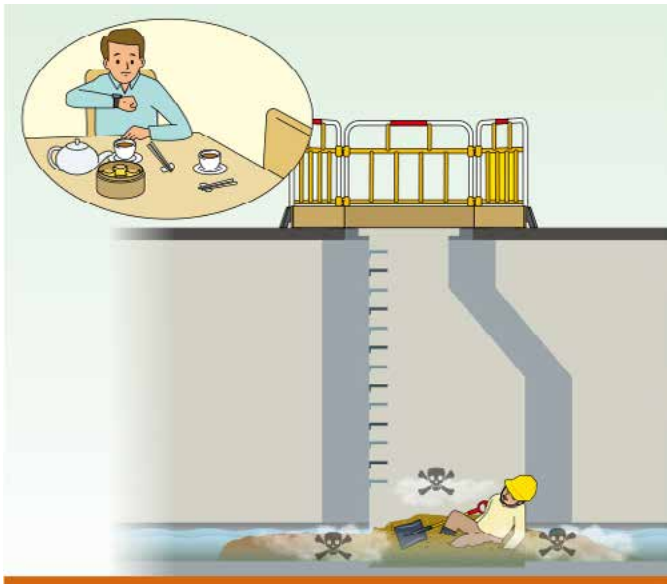
Most gas poisoning incidents in drainage works occur as a result of improperly identifying the dangers of atmospheric hazards in the workspace or ignoring safety procedures so as to get the jobs done more quickly. After investigation of previous accidents with casualty, six reasons in relation to inadequate safety awareness are summarized as follows:

1. Rush for tight schedule and inadequate assessment of risks associated;
2. Not adopting control measures and using personal protective equipment to save the bother;
3. Not aware of the risk of sudden ingress of toxic gases;
4. Lack of a standby person stationing outside the manhole for communication and emergency response;
5. Disregard the risk of sudden ingress of toxic gases as a result of the engineering work; and
6. Ignore the risks of conducting drainage work in a poorly ventilated environment.

1. Rush for tight schedule and inadequate assessment of risks associated

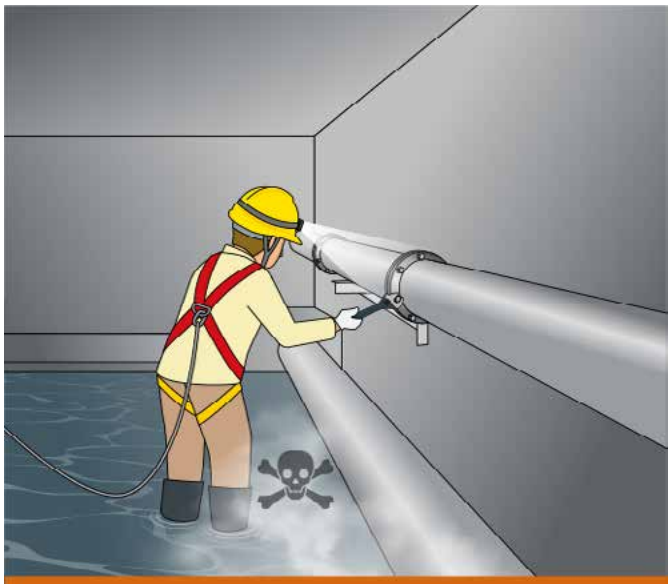
2. Not adopting control measures and using personal protective equipment to save the bother

3. Not aware of the risk of sudden ingress of toxic gases



4. Lack of a standby person stationing outside the manhole for communication and emergency response

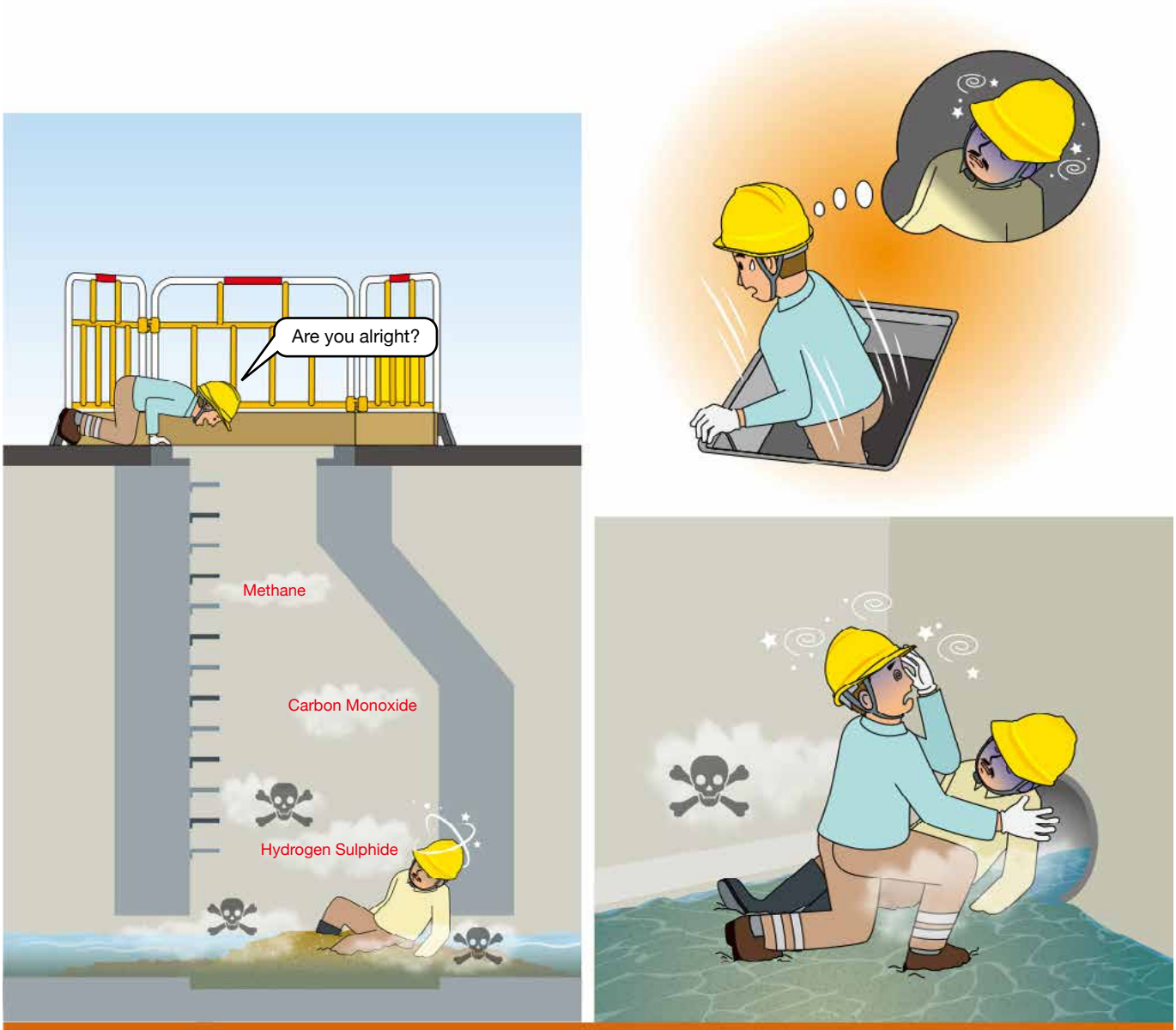
5. Disregard the risk of sudden ingress of toxic gases as a result of the engineering work



6. Ignore the risks of conducting drainage work in a poorly ventilated environment

4.2 Inappropriate Emergency Rescue

When a worker is found unconscious inside a drainage, the co-workers often instinctively enter the drainage immediately in an effort to rescue the worker even though they neither have proper rescue equipment nor proper training. As a result, the co-workers are also succumbed to the gas poisoning.



Even in an emergency, the standby person should not enter the confined space. He should remain stationed outside and summon the assistance of rescue

4.3 Performing Underground Pipework Improperly

4.3.1 Some proprietors or contractors do not correctly classify the relevant drainage works as underground pipework, and therefore fail to ensure, as required in section 9 of F&IU(CS)R, the use of appropriate personal protective equipment by workers entering or remaining in the confined space. This can cause very serious gas poisoning incidents.

4.3.2 Typical underground pipework include (1) workers are required to enter any underground drains or their associated manholes, which have been classified as confined spaces, to carry out inspection or maintenance of drainage works, etc.; (2) workers are required to enter any underground confined spaces for inspection or maintenance work of pipes.

4.3.3 Some proprietors or contractors mistakenly believe that when some control measures are taken, the inspection or maintenance of pipelines or gas supply pipes in an underground confined space can be changed to become non-underground pipework, so that it is not required to follow section 9(b) of the F&IU(CS)R. Such misconception and improper practice will often result in serious gas poisoning accidents, in particular when some of the control measures are failed.

Worker did not use the approved breathing apparatus required for underground pipework

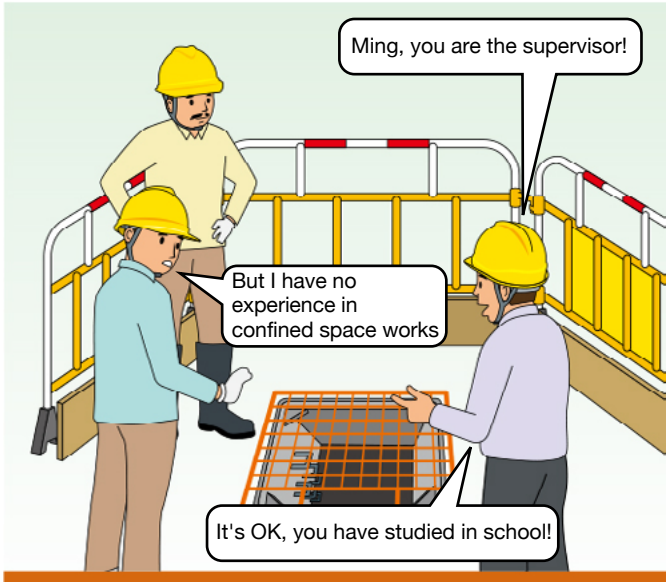
4.4 Lack of Continuous Air Monitoring

The air composition in drains can be changed rapidly due to work processes, activities, or other environmental factors. For example, welding process will reduce the oxygen content in the drainage. If workers do not monitor the air composition continuously, it is difficult for workers to determine the presence of hazardous gas or oxygen deficiency in the working environment. This situation will lead to severe consequences.

Workers did not monitor the air composition continuously and unable to determine change in the working environment

4.5 Inadequate Frontline Safety Management and Supervision

Some frontline supervisory personnel do not seriously supervise the safety precautions when certified workers enter a confined space. For example, they do not check whether certified workers have properly worn the breathing apparatuses, whether the audio and visual alarms and gas monitoring devices have been activated, etc. Some proprietors or contractors even underestimate the dangers of working in confined spaces and do not assign persons with relevant confined space experience as safety supervisory personnel. These management attitudes often result in gas poisoning incidents, which are avoidable.



Did not assign persons with relevant confined space experience as safety supervisory personnel

Did not check whether certified workers have properly worn the protective equipment, e.g. audio and visual alarms, gas monitoring devices

5. Atmospheric Hazards in Drainage Works

Workers engaged in drainage works may be exposed to atmospheric hazards such as hazardous gases, fumes and vapours during operation. In general, the health impact of these atmospheric hazards depends on a number of factors, including the toxicity of harmful gases, fumes and vapours, concentration and amount inhaled by workers, etc. Some atmospheric hazards can cause workers to lose consciousness quickly and even poisoned to death, while others can have chronic effects on workers' health. Therefore, a good understanding of the atmospheric hazards is essential for the prevention of gas poisoning.

5.1 Sources of Hazardous Gases, Fumes or Vapours

5.1.1 Hazardous gases may be present naturally in a drainage system. However, some may arise from the work being carried out. The enclosed nature of the workspace may increase the danger, as hazardous gases can accumulate in the work area and their concentrations in air can rise rapidly. Typical sources of hazardous gases present in drainage works include the following:

- Decomposition of organic matters in sewers, manholes and pits of the drainage system will generate methane and/or hydrogen sulphide. Hydrogen sulphide, being very soluble in water, often dissolves in sewage and can be trapped within sediment and sludge in sewers as gas pockets. Disturbing the sewage, sediment or sludge, or cleaning the deposit can release the trapped or dissolved gas. The concentration of the harmful gas in the air can even rise rapidly, resulting in a very dangerous situation;

- Leaks of hazardous gases from underground fuel tanks, gas supply pipes, connected sewer systems or contaminated land, such as landfills, may enter the work area;
- Residues in or on tank or silo may release hazardous gases, fumes and vapours;
- Hazardous gases, fumes and vapours can be generated due to work or equipment nearby being improperly performed or isolated. For examples,
    - o leaks from pipes which are connected to the confined space;
    - o the use of generators and fuel-driven tools that can consume the oxygen and generate carbon monoxide;
    - o hazardous gases, fumes and vapours released from the chemical substances being discharged into underground drains in industrial areas; or
    - o welding or the use of volatile solvents, adhesives, etc, that can generate hazardous gases, fumes or vapours.

5.2 Characteristics of Common Hazardous Gases

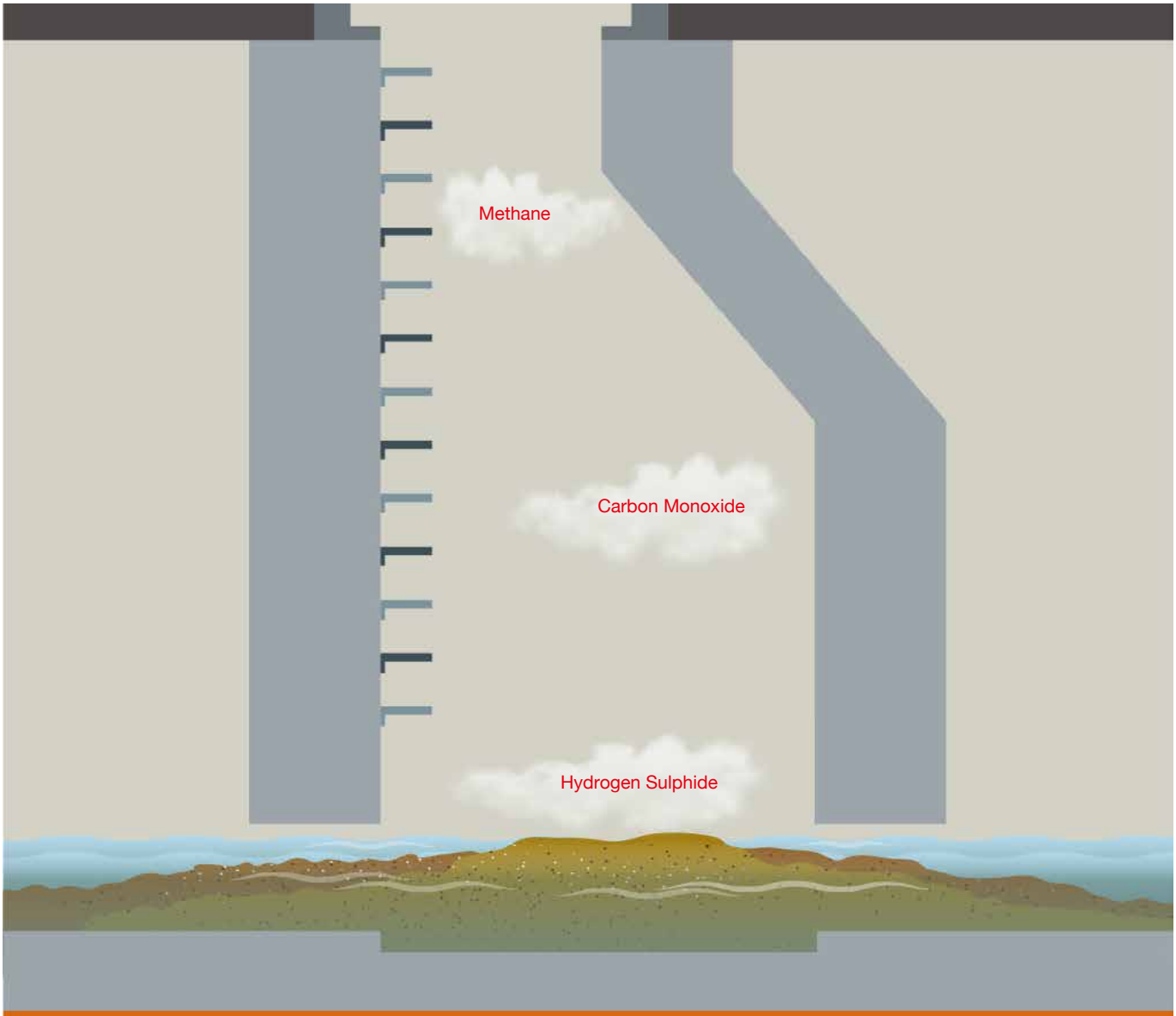
5.2.1 A number of hazardous gases, such as carbon monoxide, are colourless and odourless. On the other hand, some hazardous gases like hydrogen sulphide may have an unpleasant smell at low concentrations but such smell disappears at higher concentrations due to olfactory fatigue. It can be very dangerous if drainage workers think they can easily recognise the presence of toxic gases by smell.

5.2.2 Hydrogen sulphide, carbon monoxide and methane are the most common hazardous gases found in drainage worksites. In addition, oxygen deficiency is another major cause of worker's loss of consciousness or asphyxiation. The characteristics of these hazardous gases are summarised as follows:

Hazardous gas	OEL-TWA (ppm)	IDLH (ppm)	Relative density (air=1.0)	LEL/UEL	Remarks
Hydrogen Sulphide (H_2S)	10	100	1.2	4.3% / 45.5%	Rotten egg smell; Olfactory fatigue, coma and death by suffocation at high concentrations
Carbon Monoxide (CO)	25	1,200	1.0	12.5% / 75%	Colourless and odourless; Confusion, coma and death by suffocation at high concentrations
Methane (CH_4)	---	---	0.6	5.3% / 15%	Colourless and odourless; Displace air causing asphyxiation and death

Note:
ppm – Parts per Million
OEL-TWA – Occupational Exposure Limit - Time-Weighted Average
IDLH – Immediately Dangerous to Life or Health Concentration
Relative density – <1.0 means lighter than air; > 1.0 means heavier than air
LEL/UEL – Lower Explosive Limit / Upper Explosive Limit

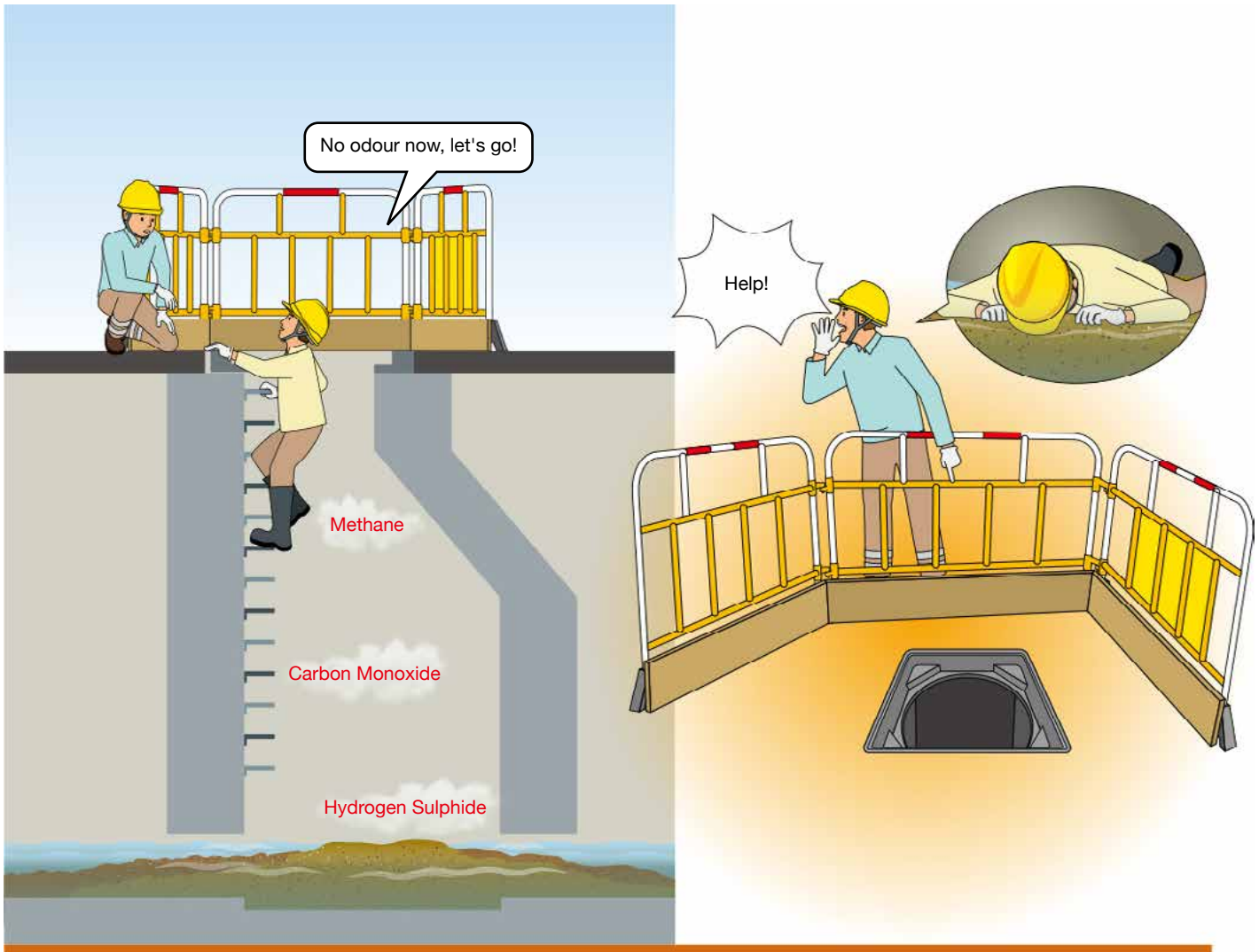
5.2.3 Hazardous gases of different densities may accumulate at different levels and locations in the confined space (as shown in the figure below). Gases heavier than air will fall in the lower part of the confined space, while gases lighter than air will accumulate in the upper part of the confined space.



Hazardous gases of different densities may accumulate in the confined space at different levels and locations

5.2.4 Hydrogen sulphide (H_2S)

Hydrogen sulphide is a deadly gas with a distinctive “rotten egg” odour that can be detected at very low concentrations. At concentrations above 100 ppm, hydrogen sulphide has a paralysing effect on the sense of smell. Even at lower concentrations, hydrogen sulphide can affect the olfactory nerve and workers cannot detect the changes in concentrations. Therefore, it is very dangerous to rely on the smell to detect the presence of hydrogen sulphide. A more reliable method for detecting hydrogen sulphide is by using a calibrated gas detector. An airborne concentration of hydrogen sulphide above 100 ppm is immediately dangerous to life or health and concentrations over 1,000 ppm could cause immediate collapse. Moreover, as sewage is often present in a drainage system, workers overcome by hydrogen sulphide could be easily killed by drowning, even though the water level is shallow.



Do not rely on the smell to detect the presence of hydrogen sulphide or other toxic gases

5.2.5 Carbon monoxide (CO)

The lethal colourless and odourless gas – carbon monoxide, is given off when charcoal is burnt in poorly ventilated areas. Similarly, it is produced when gasoline/diesel generators or other fuel-driven tools are used in inadequately ventilated workplaces. Exposure to carbon monoxide at concentrations over 350 ppm can cause confusion, fainting on exertion and collapse. An airborne concentration of carbon monoxide above 1,200 ppm is immediately dangerous to life or health.

5.2.6 Methane (CH_4)

Methane is commonly generated when organic matter is decomposed by a variety of bacterial processes. It is a colourless, extremely flammable and explosive gas that can cause fire and explosion. The accumulation of methane in a poorly ventilated area will displace normal air and result in an oxygen deficient environment. Typical gas monitoring devices for confined spaces do not directly measure methane concentration. Instead, users can determine the presence of methane through the oxygen level and percentage of lower explosion limit (LEL) shown by the device.

5.2.7 Oxygen deficiency

The percentage of oxygen in the confined space should be not less than 19.5% and not more than 23.0% by volume at normal atmospheric pressure. The enclosed nature of the confined space may cause a reduced oxygen level inside, resulting in an oxygen-deficient environment, which can suffocate workers. The following are common causes of the reduction of oxygen level in confined spaces:

- Oxygen is consumed during the welding process. Oxygen deficiency inside confined spaces occurs when ventilation is insufficient;
- The soil reacts with the oxygen in the air and the oxygen is absorbed by the components in the soil;
- The inner part of the steel tanks and containers is rusting, which reduces oxygen in the air during the rusting process;
- When using inert gas to remove flammable or hazardous gases, the inert gas will displace normal air, resulting in an oxygen deficient environment.

6. Risk Assessment and Safety Precautions for Prevention of Gas Poisoning

The most effective way to prevent workers from gas poisoning is to adopt, as far as practicable, other practical methods without requiring workers to work in the drainage that is defined as confined space. If the confined space work is unavoidable, the proprietor or contractor shall formulate a safe system of work, which consists of the risk assessment, the method statement, and implementation, supervision and review of the safe system of work prior to the commencement of any associated work. The method statement and safe system of work should be formulated and endorsed by the proprietor or contractor responsible for the work with reference to the results and recommendations in the risk assessment report submitted by the competent person. Moreover, written and verbal information and instructions should be provided to all personnel involved before the drainage works begin.

6.1 Risk Assessment

6.1.1 Risk assessment and method statement

6.1.1.1 According to section 5 of the F&IU(CS)R, when work is to be undertaken in a confined space, the proprietor or contractor shall appoint a competent person to carry out a risk assessment of the working conditions in the confined space, to identify all relevant hazards, including specified risks of loss of consciousness or asphyxiation of any person at work due to gases, fumes, vapours or lack of oxygen. Basing on the assessment results, the competent person should make recommendations on safety precautions to be taken before and during the drainage works to ensure the safety and health of workers.

6.1.1.2 The risk assessment should identify the hazards to workers performing drainage works as well as the others in the close proximity who may be affected by the work to be carried out, taking into account of important factors such as potential sources of inhalation of hazardous gases, vapours, fumes or lack of oxygen, and other hazards inherent in the work, proposed work methods, industrial plants, materials, and the design of the drainage Itself. The competent person should consider not only the hazards arising from the drainage, but also those stemming from the other industrial plants, processes and operations in the vicinity, such as inadvertent contact with or damage to the utilities nearby during the work.

6.1.1.3 The risk assessment report should include the level of risk to all the persons involved as well as the safety precautions to be taken. It is necessary to consider and specify the size, number and distribution of drainage inlets, the number of workers that can remain safely in the drainage, and the problems and efficiency of the evacuation or rescue operation. The competent person shall submit the report to the proprietor or contractor. All relevant records shall be kept for not less than one year for future reference and review, and they should be made available, on request, to the occupational safety officer of the LD.

6.1.1.4 After the risk assessment has pointed out the hazards and relevant recommendations on safety precautions, the proprietor or contractor shall verify that such risk assessment report covers all matters referred to in section 5(2) of the F&IU(CS)R, and formulate the method statement for the drainage works.

6.1.1.5 The method statement should record details of all relevant processes, work procedures, safety precautions, relevant equipment, workers' qualifications and training requirements, etc., and include the implementation of a permit-to-work system. For the risk assessment and permit-to-work system related to confined spaces, please refer to section 6.2.1 of this Guidance Notes and the "Code of Practice - Safety and Health at Work in Confined Spaces".

6.1.2 Assessment of underground pipework

6.1.2.1 According to section 9(b) of the F&IU(CS)R, where a person has to enter a confined space for underground pipework, the proprietor or contractor should ensure that (1) a person entering or remaining in that confined space is properly wearing an approved breathing apparatus, and (2) the person is wearing a suitable safety harness connected to a lifeline so that the person can be pulled out of the confined space in an emergency.

6.1.2.2 The competent person appointed to carry out risk assessment should assist the proprietor or contractor in assessing whether the confined space work is an underground pipework to ensure compliance with section 9(b) of the Regulation. To assess whether a work is an underground pipework, factors to be considered include (1) whether the work is conducted inside a confined space; (2) whether the aforesaid confined space is underground; and (3) whether the work involves any pipes or their associated work. Typical underground pipework include (1) workers are required to enter any underground drains or their associated manholes, which have been classified as confined spaces, to carry out inspection or maintenance of drainage works, etc.; or (2) workers are required to enter any underground confined spaces for inspection or maintenance work of pipes. The proprietor or contractor must note that whether the nature of a confined space work is underground pipework or not can, under no circumstances, be changed by taking any control measures, and that is, therefore, not justifiable for not complying with section 9(b) of the Regulation.

6.1.3 Determination of the presence of sludge or other deposits

6.1.3.1 According to section 5 of the F&IU(CS)R, the competent person appointed to carry out the risk assessment is required to assess the presence of sludge or other deposits in the confined space. When there is a possibility that the sludge or deposits will give off hazardous gas, vapour, dust or fume, the competent person should recommend the use of approved breathing apparatus. When there are sludge or deposits present in the drainage works site, the trapped or dissolved hazardous gases such as hydrogen sulphide are very likely to be released due to disturbance of the sludge, sediment or sewage during work, thus increasing the risk of gas poisoning. In this circumstance, the competent person must recommend the use of approved breathing apparatus by workers in the risk assessment, and recommend the use of suitable gas detector (should be explosion-proof type) for continuous air monitoring in the confined space until everyone leaves the confined space. The preferred method of continuous air monitoring is carrying suitable gas detectors by certified workers working inside confined spaces.

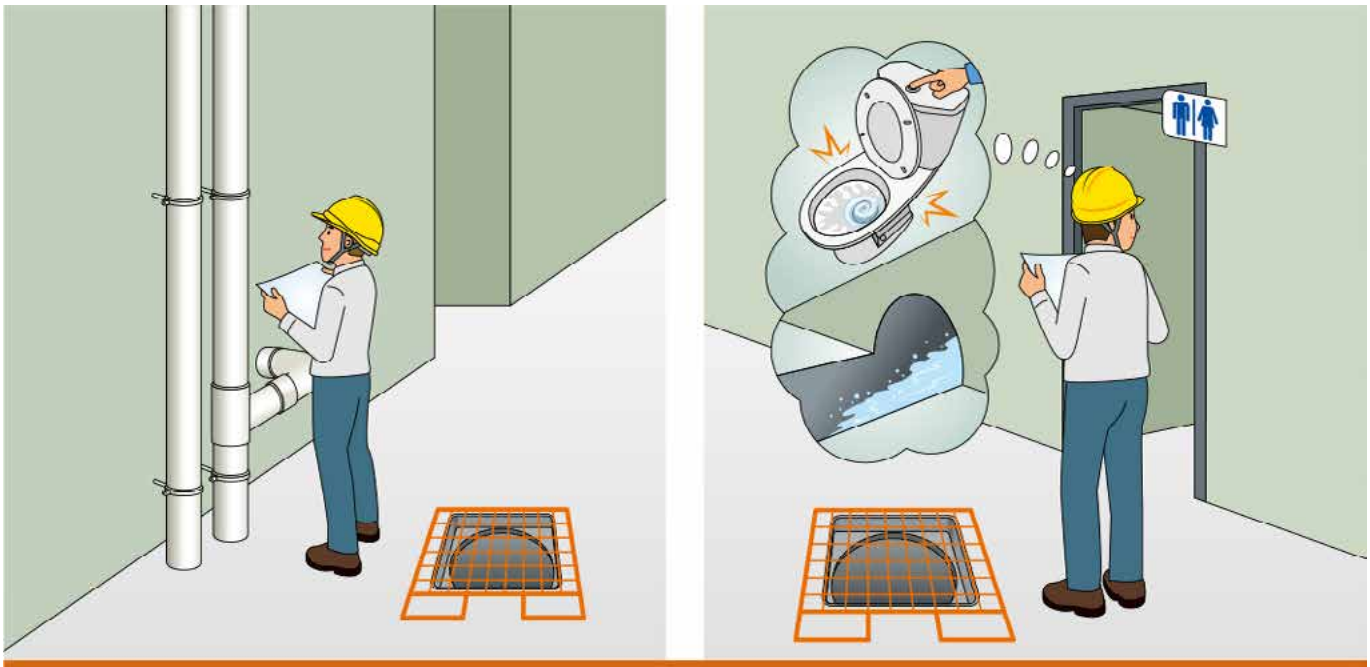
6.1.4 Assessment of atmospheric hazards

6.1.4.1 Collection of all relevant information of the drainage works

The risk assessment shall be conducted by a competent person before the work starts. The competent person should:

- understand the work methods to be employed, the plant and materials to be used, and the physical layout and surrounding environment of the drainage worksite. This can be done by conducting an on-site survey and studying the relevant information of the underground facilities, drawings and work plans.

- identify and assess all the potential atmospheric hazards that may exist before the work begins as well as those that may emerge in the course of the work. Even if hazardous gases, fumes and vapours may not be present initially, they may be released while the work is in progress inside the drainage. For example, if sludge or sewage containing hydrogen sulphide is disturbed, the hydrogen sulphide gas will be released quickly and accumulated in the confined space to hazardous levels. Also, sudden ingress of hazardous gases to newly built drainage from existing sewers is not uncommon.



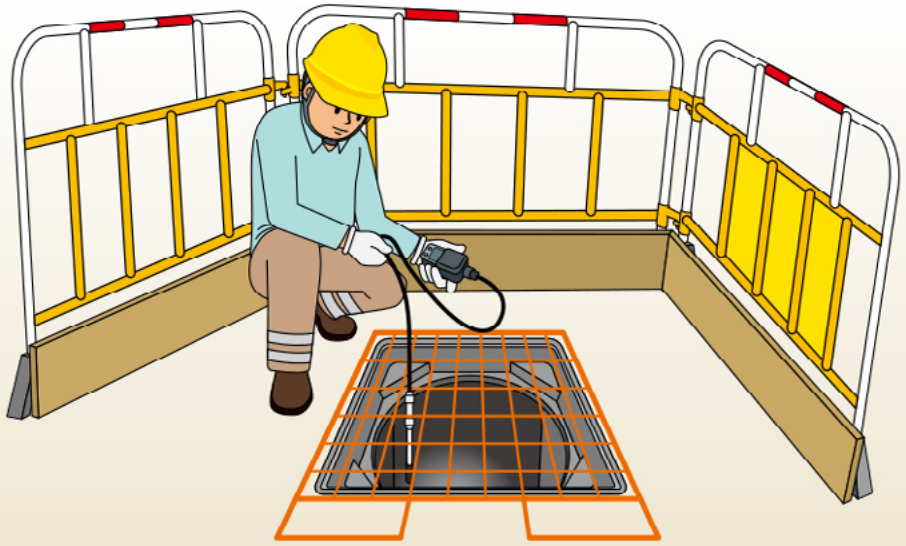
The competent person should consider all relevant information carefully, including the work methods, the surrounding environment and the potential atmospheric hazards

6.1.4.2 Air monitoring

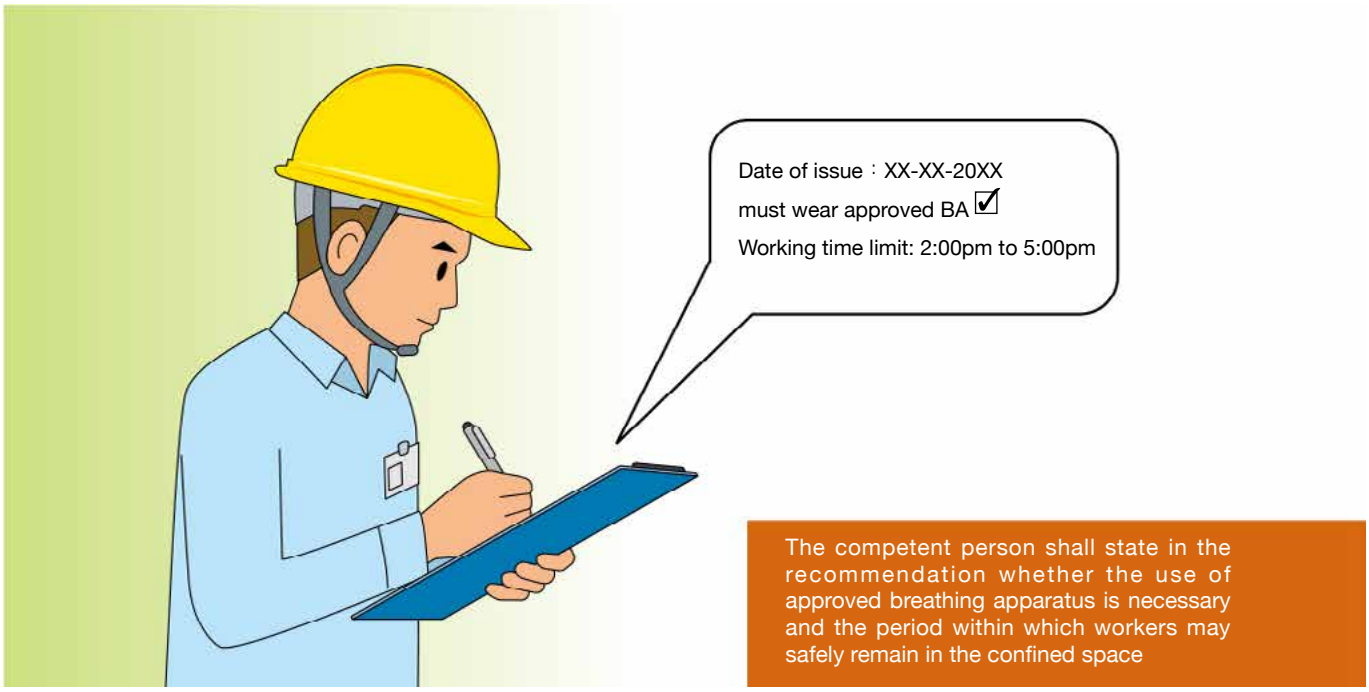
Air monitoring should be conducted by a person with appropriate training and experience, e.g. competent persons including registered safety officers with at least one year of experience in air monitoring in confined spaces, occupational hygienists, etc. Air monitoring includes pre-entry atmospheric testing and atmospheric monitoring during the work.

- The competent person shall recommend continuous air monitoring if the risk assessment shows that there could be adverse changes in atmospheric conditions.

- The competent person shall state in the recommendation whether the use of approved breathing apparatus is necessary and the period within which workers may safely remain in the confined space.



The competent person shall recommend continuous air monitoring if the risk assessment shows that there could be adverse changes in atmospheric conditions



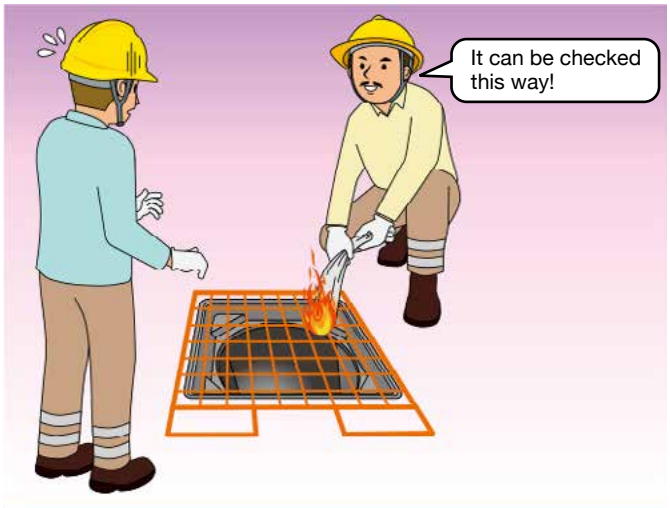
The competent person shall state in the recommendation whether the use of approved breathing apparatus is necessary and the period within which workers may safely remain in the confined space

Air monitoring does not end with the pre-entry test. Since atmospheric conditions within a drainage workspace can change rapidly, it is necessary to perform continuous air monitoring to ensure that the air quality remains acceptable throughout the work. Each group of workers (at the same working location) should bring alone with at least one portable air monitoring equipment to conduct continuous air monitoring during drainage work. The equipment should be checked to ensure that it is calibrated, functioning properly and with sufficient power to operate before the workers enter the drainage.

A “re-entry” test should be conducted if the workers have temporarily left the space. In fact, “re-entry” testing and pre-entry testing should be performed in exactly the same manner and should be considered equally important. In case the alarm of the air monitoring equipment is activated or any other indication of danger is observed, workers should leave the work space immediately according to the emergency procedures.

Please note the following important points on the use of air monitoring equipment:

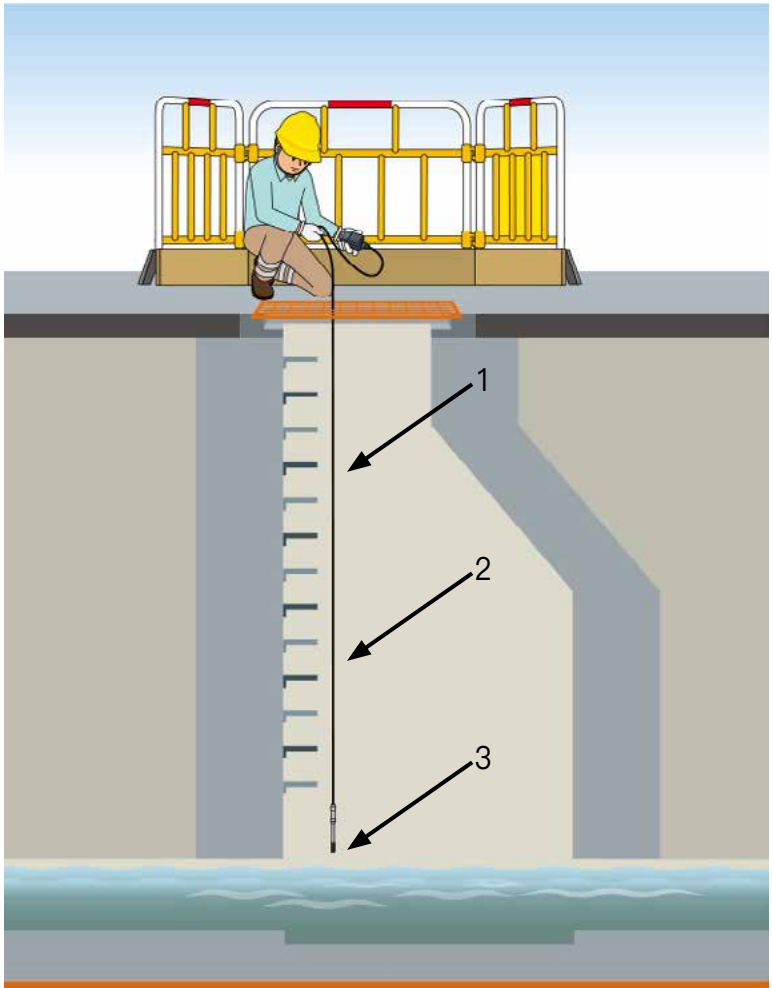
- Only properly maintained and calibrated equipment should be used for atmospheric testing. Unscientific methods such as throwing a flame down the manhole, and observing the presence of living organisms or the colour of the manhole are unreliable.
- The most common configuration for a multiple-sensor gas monitor is one that can show the readings of oxygen, combustible gases, hydrogen sulphide and carbon monoxide. Never assume that the hazardous gases present in the drainage are limited to these gases. Different or additional air monitoring equipment is required for other hazardous gases (e.g. chlorine) that may be present in the drainage.
- The proper functioning of the air monitoring equipment should be tested before use according to the manufacturer's instructions, i.e. functional or bump/challenge test.
- The atmosphere in the drainage should, as far as practicable, be tested by using remote probes and sampling lines connected to direct-reading instruments placed outside the drainage.
- The atmosphere around the working position of the person carrying out the air monitoring should be tested first to ensure his safety and health during the air monitoring.
- In general, testing for oxygen should be performed first because some gas sensors are oxygen dependent and could give unreliable readings in oxygen deficient situations. Even though it may still be sufficient for survival, any depletion of oxygen should be further investigated.
- Testing of the atmosphere inside the drainage should be done from the top to the bottom of the confined space, preferably at about 1-metre intervals. Sampling for a few minutes at each location is required as there will be a time lag for the gas to be pumped from the sampling probe to the monitoring equipment.
- Record the results with the time and location of the atmospheric monitoring in the risk assessment.
- Atmospheric monitoring must be conducted again when there is any potential change in the atmospheric conditions.



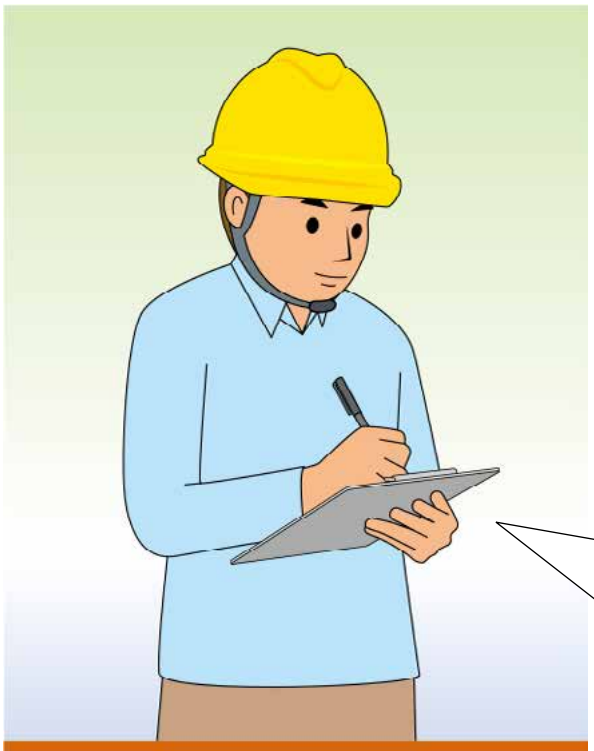
Never rely on unscientific methods in air monitoring

Various air monitoring instruments may be required to assess the potential atmospheric hazards in drainage works

Conduct bump/challenge test according to the manufacturer's instructions



Air monitoring should be conducted at different levels of a manhole



Location	Time	O_2 (%)	
near manhole	15:03	20.9	2
1 m below manhole	15:06	20.7	20
2 m below manhole	15:09	20.9	2
m below manhole	15:12	20.9	

Record the results with the time and location

6.1.5 Example of risk assessment

To assist competent person to have a detailed grasp of the risk assessment of drainage works, a "Sample of Risk Assessment for Confined Space (Drainage Works)" and an example of its use are provided in Appendix 1 and Appendix 2 respectively of this Guidance Notes for reference.

6.2 Safety Precautions

6.2.1 Permit-to-work system

a) The implementation of permit-to-work system is an indispensable part of the safe system of work for working in confined spaces. The proprietor or contractor should implement a permit-to-work system to tie in with the risk assessment of the confined space work.

b) After receiving a risk assessment report completed by a competent person, the proprietor or contractor shall verify that the report has covered all the matters referred to in section 5(2) of the F&IU(CS)R. The proprietor or contractor should issue a permit-to-work certificate only when all necessary safety measures have been implemented, including all necessary safety precautions specified in the risk assessment.

c) The proprietor, contractor or his authorized person should sign on the permit-to-work certificate to confirm that all safety precautions indicated on the certificate have been implemented effectively. If the proprietor or contractor authorizes a person to issue a permit-to-work certificate, the person should have sufficient knowledge of working in confined spaces and the safety precautions to be taken. In general, the authorised person should be a competent person as defined in the F&IU(CS)R (e.g. a safety officer registered under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations with at least one year of relevant experience in confined space works). Since the person issuing the permit-to-work certificate needs to verify the contents of the risk assessment report as above mentioned, the person being authorised to issue the permit-to-work certificate should not be the competent person who completed the risk assessment report. Moreover, the person issuing the permit-to-work certificate should also clearly explain the content of the certificate to all workers and related persons involved in the confined space.

d) In addition, the person responsible for signing and accepting the permit-to-work certificate should be the one who is responsible for stationing outside the confined space, that is, the on-site supervisor or the person-in-charge of the work in the confined space. The signer should read and fully understand the content of the permit-to-work certificate and undertake the work in accordance with all the conditions laid down in the certificate.

e) The proprietor or contactor can set out in the permit-to-work certificate the work to be done and the items to be checked before entering a confined space, and the necessary precautions to be taken to ensure safety and health at work in the confined spaces. At the same time, the permit-to-work certificate should record the following:

   i. the findings in the risk assessment report completed by the competent person;

   ii. the effectiveness of the isolation and withdrawal from service;

   iii. the amount of sludge or other deposits (if any) after cleaning;

   iv. the results of the atmospheric testing;

   v. whether the nature of work to be done involves underground pipework;

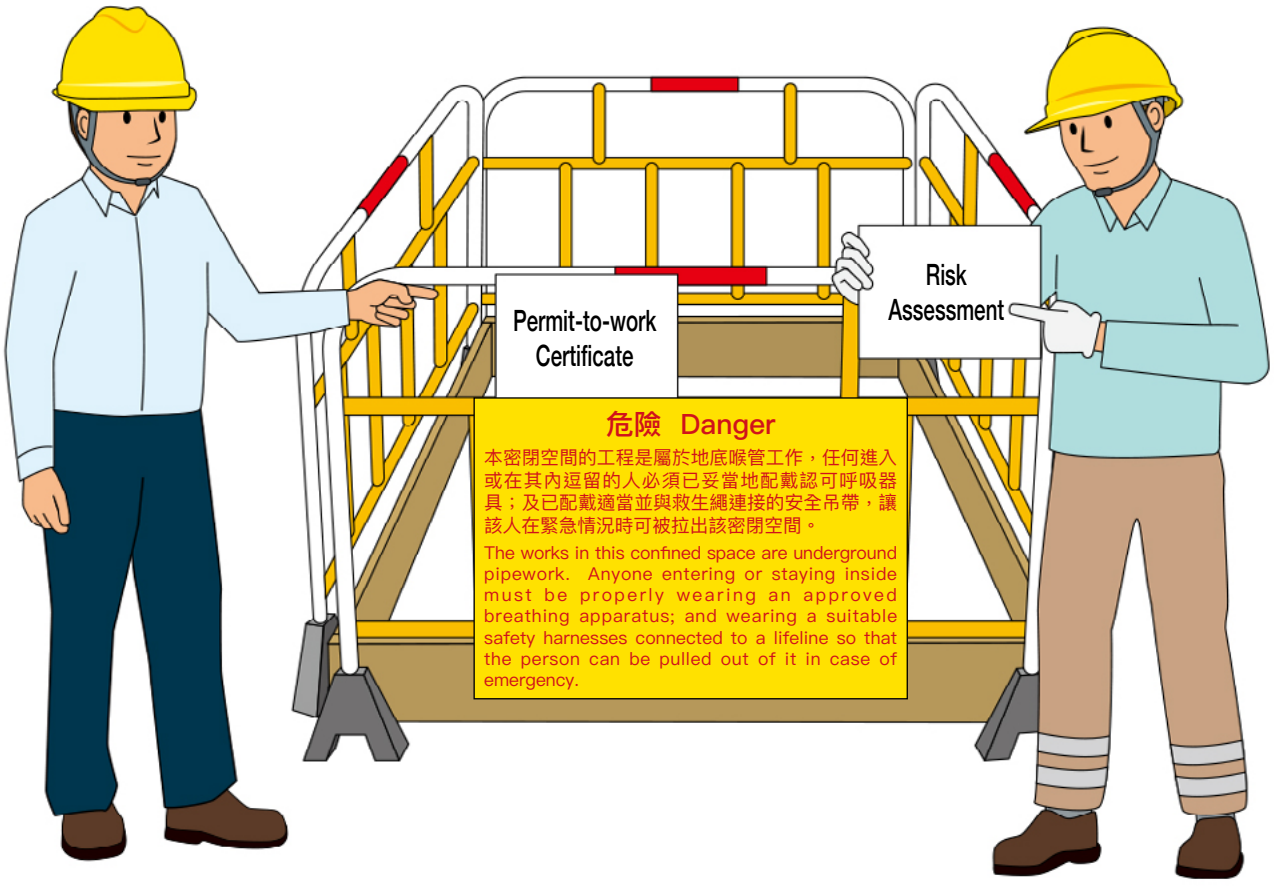
   vi. the condition and features of the confined space;

vii. list of personal protective equipment (including approved breathing apparatus and safety harnesses connected to lifelines, etc. must be properly worn by workers when underground pipework are involved);

viii. the period during which workers may remain safely in the confined space (The period shall not exceed the permissible time limit specified in the risk assessment report); and

ix. other appropriate safety precautions.

f) For the requirements, details and record keeping of the permit-to-work certificate, please refer to the "Code of Practice - Safety and Health at Work in Confined Spaces". A "Sample of Permit-to-work Certificate for Entry into Confined Space (Drainage Works)" and an example of its use are provided in Appendix III and Appendix IV respectively of this Guidance Notes for reference.



Workers should be issued a valid permit-to-work before entering the manhole to work

6.2.2 Control measures for prevention of gas poisoning

6.2.2.1 Avoid working inside drainage involved confined space

The proprietor or contractor should adopt technology or other methods to prevent workers from entering drainages involved confined spaces as far as practicable. Proper planning of work or switching to another work method can reduce the need to work in confined spaces. For example, inspecting the internal part of a sewer by remote control monitoring; using suitable equipment and tools to perform sampling and cleaning work from outside of the confined space without requiring workers to enter the drainage.

Avoid working inside drainage

6.2.2.2 Isolation

a) The proprietor or contractor shall, before allowing workers to enter a confined space, ensure that the confined space has been securely and completely isolated and separated from all the other connecting parts so as to prevent any materials which are liable to create a hazard from entering a confined space.

b) All the points of isolation should remain fully secure to ensure that the dangerous materials will not go into the confined space whilst the workers are working in it.

c) The proprietor or contractor shall ensure that all pipes and supply lines, which are liable to cause danger, are completely blanked off, and effective steps to prevent an ingress to the confined space of hazardous gas, vapour, dust or fume, or in-rush of mud, water or other free flowing liquids and solids are taken. Regarding in-rush of water, particular attention should be given to the possible sudden changes in water level in drainages due to rainfall in the catchment area, changes in tide levels, sudden discharge of floodwater into the drainage culverts, etc.

d) It must be noted that when sewage, sediment or sludge is accidentally disturbed, hazardous gases trapped or dissolved inside may be released and therefore the concentrations of hazardous gases in air can rise rapidly.

e) The confined space shall be isolated from all unnecessary sources of power, e.g. electrical, mechanical, pneumatic, hydraulic, etc., by having them securely locked off, isolated and properly labelled as appropriate (e.g. implementing Log-out-Tag-out system) to avoid accidental switching of power back to the confined space.

f) All pipelines connected to a confined space shall be completely shut off or blanked off as appropriate. All connected valves should be fully closed, locked off and properly labelled as appropriate (e.g. implementing Log-out-Tag-out system) to prevent being opened without authorization or accidentally.

g) Ends of service pipes which are still connected to sources of hazardous gases should be properly sealed by means of metal blank, end-cap., etc.

Pipes or supply lines that are liable to create a hazard in the confined space must be properly blanked off

6.2.2.3 Purging

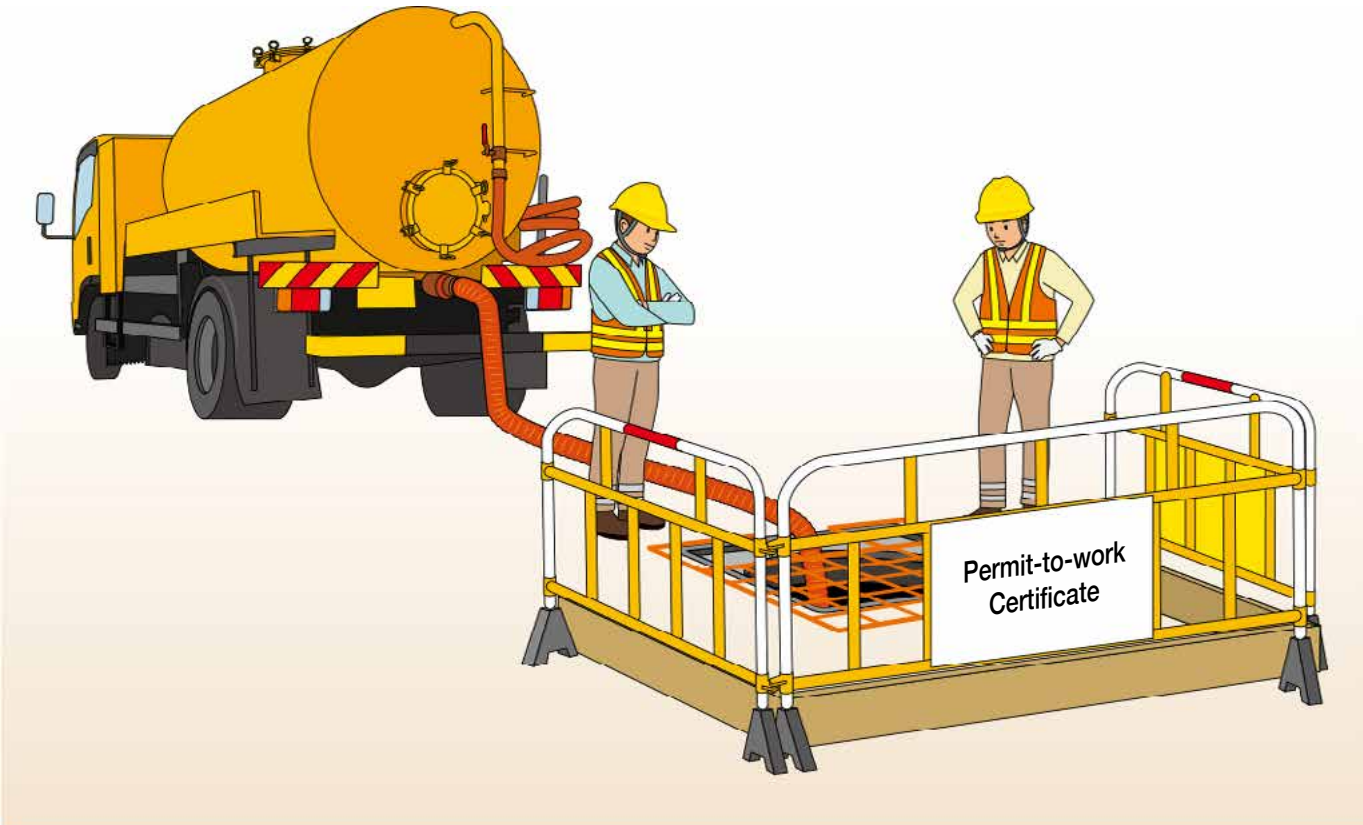
Risk assessment must be conducted to review the possibility of presence of hazardous gas, vapour, dust or fume in the confined space. Before the proprietor or contractor allows workers to enter into and work in a confined space, the confined space shall be adequately purged by suitable method, such as steam cleaning, inert gas purging and forced ventilation to remove all the hazardous substances contained in the confined space. In addition, mechanical tools such as vacuum and jet cleaners can be used to remove wastes such as grit, sludge and sewage from the channel system to eliminate the source of harmful gases.

a) Steam cleaning

- Steam-volatile substances in confined spaces could be removed by steam cleaning.
- For removal of corrosive materials, or materials which are not readily volatile, preliminary treatment by repeated washing with water, or with other suitable solvents or appropriate neutralizing agent should be applied prior to steaming.
- The period of steaming should be adequate to thoroughly remove all the dangerous materials from the confined space. The required period should be decided and checked by the person who has been appointed by the proprietor of the industrial undertaking for the steaming work.
- It would be necessary to re-steam where the confined space has been left for more than a few hours after steaming.
- During steaming, adequate outlets for steam and condensate should be provided so that no dangerous pressure should be built up inside the confined space.
- After steaming, adequate air inlets should be provided so that there should not be any vacuum being caused in the confined space by cooling and condensation. To prevent any heat stress problem, sufficient cooling of the confined space to room temperature is essential before allowing workers to enter the space.
- When purging has been completed, all liquid remaining in the confined space should be drained away or pumped out as appropriate, and manholes should be opened to allow ventilation.

b) Inert gas purging

- To avoid the formation of an explosive mixture with air when a confined space containing flammable gas or vapour is opened up, the confined space may be purged by an inert gas (e.g. nitrogen, carbon dioxide).
- If persons have to enter or approach a confined space which has been purged by an inert gas, the confined space should be purged again by fresh air so as to provide adequate oxygen into the confined space to support life. Thereafter, all parts of the air-purged confined space should then be thoroughly tested against the deficiency of oxygen to make sure that there is adequate oxygen to support life.
- Consideration should be given to the possibility that workers outside the confined space may be exposed to hazardous substances such as harmful gases, vapours, dust or fumes that are discharged after purging the confined space with inert gas. Effective precautions must be adopted to avoid inhalation of such hazardous substances by workers outside the confined space and nearby.



Remove sludge and sewage to eliminate the source of hazardous gases

6.2.2.4 Ventilation

a) It is very dangerous to enter a confined space without adequate ventilation. The proprietor or contractor must ensure adequate and effective ventilation is maintained for supplying sufficient respirable fresh air for workers inside the entire confined space of drainage works. In that respect, forced ventilation may be required to replace natural ventilation.

b) Mechanical ventilation should be used to dilute the air contaminants in the work environment and prevent accumulation of hazardous gases.

c) Fresh air shall be supplied to the working location, but the blower must be carefully positioned to avoid drawing in contaminated air.

d) In deciding air exchange rate of the ventilation, it should take into account that some work tasks, e.g. gas welding, consume oxygen and some tasks e.g. paint spraying, contaminate the atmosphere. It would be required to provide adequate air change to remove the hazardous substances evolved and maintain sufficient fresh air supply while work is in progress.

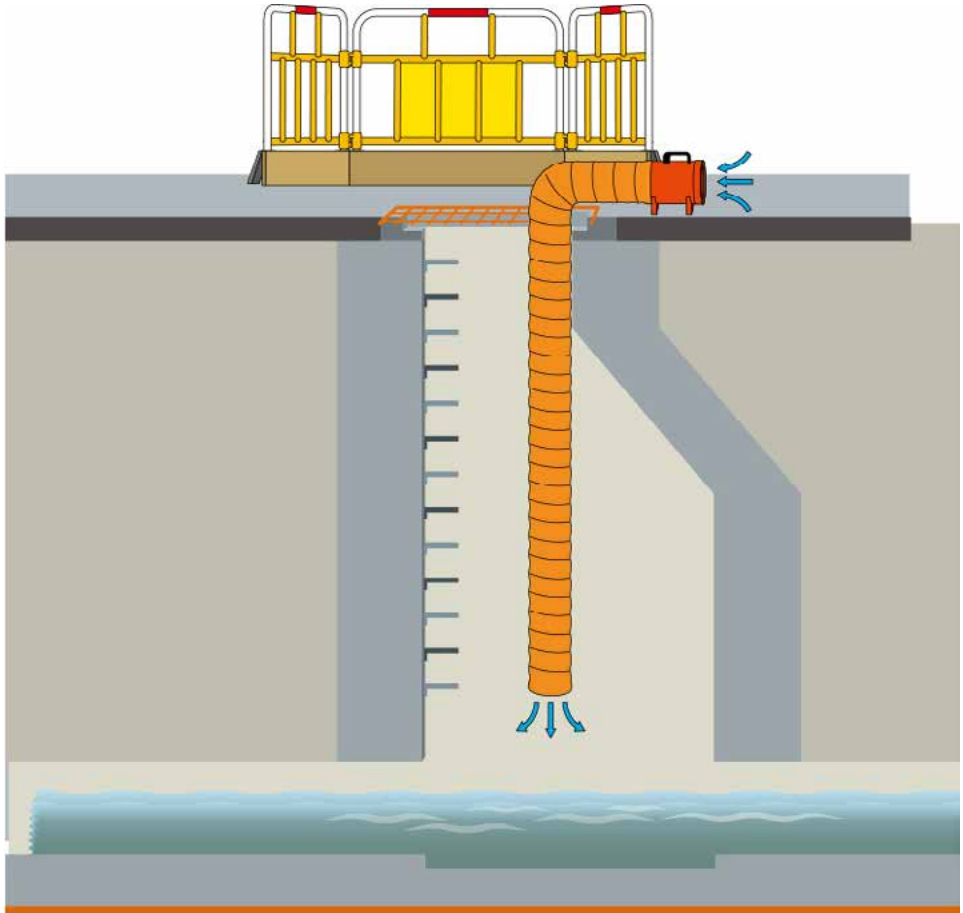
e) If a local exhaust system is used to control air contaminants in the confined space, the exhaust hood should be close to the source of the contaminants to ensure the effectiveness of the exhaust system, and reduce the risk of inhalation of air contaminants by workers.

f) The provision of ventilation to a confined space should not be regarded as an alternative to the use of approved breathing apparatus where the atmosphere inside the confined space is likely to cause safety or health hazards to the workers therein.

g) In all cases of forced ventilation to supply fresh air into a confined space, the air-line or trunking should be introduced or extended to the bottom of the confined space, for removal of gases or vapours heavier than air and for effective air circulation.

h) Under no circumstances should oxygen be introduced into a confined space which would create a danger of oxygen enrichment in the atmosphere.

i) Notwithstanding the above, the proprietor or contractor should also take effective steps to prevent an ingress of hazardous gas, vapour, dust or fume to the confined space; and an in-rush into the confined space of free flowing solid or liquid. In that respect, particular attention has to be paid to any possible ingress, in-rush, spillage or leakage of the substances through the ingress, egress or openings of the confined space from areas or places surrounded.



Fresh air should be supplied to the working location and the blower fan must be carefully located to avoid sucking in contaminated air

6.2.2.5 Personal protective equipment

a) When workers enter a confined space to carry out underground pipework, there may be additional hazards arising from the ever changing and difficult to be assessed underground environment that may result in sudden increased risk in the confined space, e.g. accidental leakage of hazardous gases, sewage or other hazardous substances from the underground pipes. In this regard, when a worker has to enter the confined space for underground pipework, the worker must observe section 9 of the F&IU(CS)R to have properly worn approved breathing apparatus and suitable safety harnesses connected to a lifeline regardless of whether the risk assessment report recommends wearing an approved breathing apparatus or not.

Workers shall wear approved breathing apparatus and a suitable safety harness connected to a lifeline in confined spaces where there are risks of the worker being overcome by hazardous gases

b) The risk assessment report prepared by the competent person shall also cover the recommendations on the measures required, having regard to the nature and duration of the work to be performed therein. The competent person shall clearly recommend in the risk assessment report whether the use of approved breathing apparatus is necessary so that the workers can stay in the confined space safely. If the concentration level of the hazardous gases is not sure, appropriate approved breathing apparatus shall be used and the other corresponding safety precautions shall be taken.

c) Where the use of approved breathing apparatus is recommended in the risk assessment report or a worker has to enter a confined space for underground pipework, the proprietor or contractor shall ensure that any person entering or remaining in that confined space is properly wearing an appropriate approved breathing apparatus with a suitable safety harness. The safety harness should be connected to a lifeline and the free end of the lifeline should be held by the standby person outside the confined space. So far as reasonably practicable, suitable and adequate mechanical aids should be provided, or lifting devices should be connected.

d) The person using the approved breathing apparatus should have received appropriate training in the use of that particular type or model of equipment. Before each use, the equipment should be:

- connected to air cylinder or other appropriate air supply equipment for providing breathable air.
- properly inspected for any physical damage on all parts and accessories.
- functionally checked according to the user manual. Tests include “high pressure leak test”, “positive pressure test”, “cylinder pressure test”, “whistle warning unit test”, etc.
- kept in clean and good conditions. Defective equipment should be clearly marked “defective” and removed from site for maintenance. Never use defective breathing apparatus.

e) The selection of a suitable approved breathing apparatus should depend on the conditions, hazards and testing results of the confined space, and the work activities to be done inside the confined space.

f) All approved breathing apparatuses to be used for entry into and work inside a confined space should well fit the workers and be properly worn.

g) The proprietor or contractor should only allow persons who are medically fit for wearing breathing apparatus to use the approved breathing apparatuses for entering into and working in a confined space.

h) The service time of self-contained type approved breathing apparatuses should be estimated having regard to the entry time, the consumption rate, the maximum working period, the estimated escape time and other relevant factors.

i) The quality of the breathing air supplied by an approved breathing apparatus should comply with the most up-to-date recognized international or national standard, e.g. BS EN 12021:2014.

j) For air-line type approved breathing apparatuses, the air supply rate should be so adjusted that a positive pressure is always maintained inside the face-pieces.

k) To avoid contamination of the air supplied, the following precautions should be taken when using air-line type breathing apparatuses:

- The air supply equipment should be maintained according to manufacturer’s instructions.
- The air intake should be properly located to avoid sucking-in of contaminated air such as engine exhaust.
- The air supply equipment used should be designed for supplying breathing air. Those designed for industrial purposes are not allowed.
- Air hose which may be oil impregnated or otherwise contaminated should not be used.

l) All approved breathing apparatuses for use in confined spaces should be properly maintained in good working condition.

m) Each worker must be equipped with a personal portable alarm. A visual and audible alarm can be generated if the worker faints in the drainage. Thus, the standby person from outside can immediately be notified and arrange for rescue. Where applicable, workers shall also be equipped with continuous air monitoring equipment which can emit visual and audible sirens so that the workers and standby persons can be informed of the danger immediately. Evacuation and the rescue can, therefore, be arranged as soon as possible.

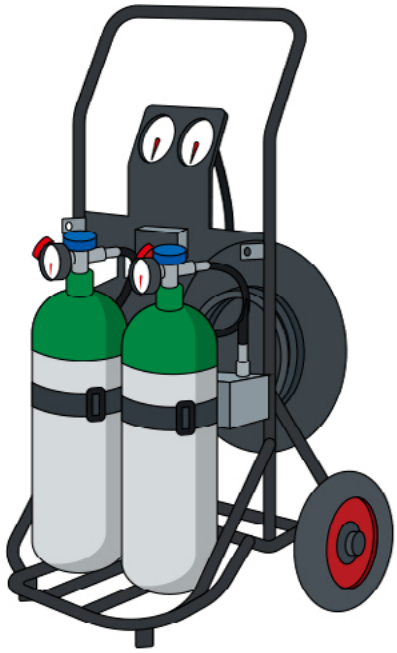
The person using the breathing apparatus should have received appropriate training in the use of that particular type or model of breathing apparatus. Before each use, the breathing apparatus should be:

- Connected to a cylinder, a pump or a compressor to provide breathable air. Care should be taken to ensure that the air compressor used for filling air cylinders or supplying air to airline type breathing apparatus is specially designed for providing breathable air, suitably maintained and properly located to avoid intake from contaminated air sources.

- Inspected for any sign of physical damage on all parts and accessories.

- Functionally checked according to the user manual. Tests include "high pressure leak test", "positive pressure test", "cylinder pressure test", "whistle warning unit test", etc.

- Kept in clean and good conditions. Defective breathing apparatus should be clearly marked "defective" and removed from site for maintenance. Never use defective breathing apparatus.



Various types of approved breathing apparatus

Check the proper functioning of the approved breathing apparatus

6.2.3 Standby persons

a) When work is being carried out in a confined space by a certified worker, the proprietor or contractor should assign another worker (the "standby person") to station outside the confined space throughout the time of operation to maintain communication with the worker inside. In addition, the proprietor or contractor should take video during the entire work period (including entering and exiting the confined space) for record and supervision purposes. The video should be kept together with the risk assessment report and the permit-to-work certificate for no less than one year after the work is completed.

b) Throughout the time of operation, the standby person shall keep the workers inside the confined space informed of any change in environmental conditions that would adversely affect their safety in the confined space (e.g. heavy rain leading to flooding, displacement of soil and materials, emergencies such as fires, spillage of toxic, corrosive or flammable liquids, releasing of dangerous gases, power supply failure, failure of forced ventilation system, etc.).

c) Similarly, the workers inside a confined space should keep the standby person informed should any dangerous situations arise inside the confined space so that the standby person can call for assistance. So, the standby person should be trained on how to maintain communication with those workers working inside the confined space.

d) Even in case of emergency, the standby person should not enter the confined space. He should remain stationed outside the confined space and summon assistance of the emergency rescue team and public emergency services (i.e. the Police and the Fire Services). He should stay outside the confined space and brief the rescue personnel of the relevant circumstances of the incident upon their arrival.

The standby person should station outside the manhole and maintain constant communication with the certified worker inside

6.2.4 Other considerations

a) Before commencement of drainage works, the proprietor or contractor shall ensure that all the necessary safety precautions recommended by the competent person have been properly implemented. Be aware of the characteristics and hazards of the hazardous gases likely to be present in the drainage system.

b) The proprietor or contractor shall ensure that all workers who enter or work in a confined space are certified workers (section 8(a) of the F&IU(CS)R. The proprietor or contractor can authorize relevant persons, such as those who issue the permit-to-work certificate, to check whether the workers entering the confined space are certified workers.

c) Do not allow workers entering a confined space alone to work inside a manhole or drainage system when there is no standby person and rescue personnel support.

d) When work is being carried out in a confined space by a certified worker, the proprietor or contractor shall ensure that the relevant risk assessment report, with all significant assessment findings, are displayed in a conspicuous place at the entrance of the confined space. The related permit-to-work certificate shall also be displayed in a conspicuous place at the entrance of the confined space (section 8(c) of the F&IU(CS)R).

e) Make sure all equipment is in good condition before use. The proprietor or contractor shall provide all necessary equipment to ensure the safety and health of workers working in a confined space (section 11(2) of the F&IU(CS)R). The equipment should be properly selected in respect of their types, purposes, functions and applications. The equipment should also be suitably calibrated, regularly checked and properly maintained, with records properly kept.

f) The proprietor or contractor shall ensure that the safety precautions, which are taken before work begins in the confined space, continue to be effective whilst the workers remain in the confined space. Keep monitoring the workspace and surrounding areas and be alert to dangerous conditions.

g) Immediately evacuate from the drainage system according to the emergency procedures if there are signs indicating that the safety and health of workers may come under threat.

h) Call for the emergency rescue team and public emergency services (i.e. the Police and the Fire Services) and implement the emergency plan in case of an accident.

i) When an accident occurs, do not enter the manhole to rescue without any rescue equipment and support from other rescuers.

Make sure all equipment is in good order before use

7. Emergency Preparedness

In the event of an emergency, effective and prompt response actions must be taken to rescue the persons involved from safety and health hazards as soon as possible. Therefore, the proprietor or contractor shall formulate, implement and maintain an emergency plan to deal with any serious and imminent dangers that workers may encounter while working in confined spaces. All workers shall be familiar with emergency procedures and conduct regular drills.

7.1 Emergency Plan

7.1.1 To rescue the persons concerned from safety and health hazards as soon as possible, the relevant workers must take effective and prompt responses in the event of an emergency. Therefore, the proprietor or contractor should identify all possible emergencies in advance, assess their effects and impacts, and formulate an emergency plan. The emergency plan should include the following elements:

a) setting priority of the possible emergencies;

b) reporting to the relevant government departments and public emergency services (the Police and the Fire Services);

c) informing all personnel involved;

d) devising escape and rescue procedures and routes;

e) forming a standby emergency rescue team consisting of a sufficient number of trained team members; and

f) providing equipment and materials as required (including the proper use of standby approved breathing apparatuses, safety harnesses and independent lifelines, life buoys, safety baskets, etc. in case of emergency).

7.1.2 Evacuation and rescue of workers must be the top priority when formulating emergency plan. It should not rely solely on the assistance of the public emergency services.

Emergency equipment and tools should be readily available on site

7.2 Alarm and Communication System

7.2.1 The proprietor or contractor shall provide adequate and effective audio and visual alarms and communication systems for workers who need to enter the confined space. If the worker faints in the drainage, a visual and audible alarm can be generated. Thus, the standby person from outside can immediately be notified and arrange for rescue.

7.2.2 Standby person shall maintain communication with certified workers inside the confined space, and remind them to be vigilant of any environmental changes in the confined space. In the event of alarming by the monitoring equipment or any other signs of danger, the standby person shall immediately assist the workers concerned to evacuate from the confined space in accordance with emergency procedures.

7.2.3 Even in case of emergency, the standby person and safety supervisory personnel should not enter the confined space. They should remain stationed outside the confined space and summon the assistance of the emergency rescue team and public emergency services (i.e. the Police and the Fire Services). When the emergency rescue team and public emergency services arrive at the scene, the standby person and safety supervisory personnel should immediately brief them on the relevant situation of the emergency for prompt assistance in rescue.

7.3 Equipment for Emergency Procedures

7.3.1 Common hazards when working in confined spaces such as hazardous gases, vapours, dust or fumes, lack of oxygen and increase in body temperature may cause workers to lose their consciousness. Therefore, the proprietor or contractor should, as far as practicable, provide appropriate lifting equipment, e.g. rescue hoist or winch, split-leg tripod with a frame-mounted hoist and one-man access cradle for rescue purposes.

7.3.2 When workers are working inside a confined space, suitable and sufficient rescue equipment, including standby approved breathing apparatus, safety harness, life-lines, resuscitators, audio and visual alarms and emergency lighting shall be provided. Properly trained rescue personnel shall be readily available for rescue purposes at all times. When work is being carried out in the confined space, the proprietor or contractor shall ensure the presence of a sufficient number of persons (appropriate to the scale of the work) who know how to use the safety equipment referred to in paragraph 7.3.

7.3.3 The rescue equipment provided should be appropriate in view of the likely emergencies identified in the risk assessment. For the use of resuscitators, reference should be made to recognized international or national standard such as the BS EN ISO 10651-5:2021 or BS EN ISO 10651-4:2009 or equivalent.

7.3.4 The breathing apparatus for escape is portable and can be used for emergency escape purpose. If the confined space work does not involve underground pipework, and the risk assessment report does not recommend the use of approved breathing apparatus to enter the confined space, every worker entering the confined space should be provided and bring along with a set of breathing apparatus for emergency escape purpose (air supply type self-rescuer).

7.3.5 The proprietor or contractor shall ensure that only approved breathing apparatus, i.e. breathing apparatus approved by the Commissioner for Labour under section 12 of the F&IU(CS)R, are used in confined spaces. Moreover, they should ensure that the quality of breathing air supplied by the breathing apparatus should comply with the most up-to-date recognized international or national standards, such as the British/European standard BS EN 12021:2014. Rated capacity of the breathing apparatus must also allow sufficient time for the user to escape to safety.

7.3.6 The proprietor or contractor should provide sufficient information, instruction, training and supervision for workers who are required to be equipped with these breathing apparatus for escape purposes to ensure that workers know how to wear and use such breathing apparatus. In addition, the proprietor or contractor should also take appropriate measures to ensure that the breathing apparatus for escape is regularly inspected, properly maintained and stored to ensure its effectiveness.

7.3.7 The breathing apparatus for escape purpose is not a substitute for an approved breathing apparatus.

7.4 Emergency Rescue Team and Drills

7.4.1 The proprietor or contractor shall formulate an emergency plan to rescue workers working in a confined space in the event of an emergency. The emergency rescue team with properly trained personnel should be ready at all times. In the event of an accident, they should be able to reach the confined space in time and rescue workers from the confined space.

7.4.2 Arrangements for emergency rescue will depend on the nature of the confined space, the risks identified and the likely nature of an emergency rescue. Account has to be taken not only of accidents arising from a specified risk, but also any other accident, for example, incapacitation after a fall.

7.4.3 As to the number of trained persons required in an emergency rescue team, several factors, including the nature of work, the hazards inherent in the confined space in relation to the work and work methods proposed, need to be considered depending on the circumstances of the case. In devising an emergency plan, the proprietor or contractor should assess the above factors against the knowledge and experience of the emergency rescue team in such work and recommend the most suitable number of rescue persons required.

7.4.4 The proprietor or contractor should ensure all members of the emergency rescue team have been properly and adequately trained in the related emergency rescue procedures, including the details of the emergency rescue plan and full knowledge on how to properly use all the rescue equipment.

7.4.5 The proprietor or contractor should arrange for regular emergency drills to ensure that all the personnel involved are familiar with the emergency procedures and to enhance their safety awareness and preparedness. In general, the drills should include the following：

a) Evacuation drills for all personnel involved. The purpose is to familiarize all the personnel with the emergency procedures, communication systems, escape routes and exits, safe assembly points, personal protective equipment, etc., and to test the effectiveness of emergency procedures and evacuation plans, and the sufficiency and suitability of emergency facilities provided; and

b) Rescue drills for emergency rescue team. The purpose is to test the capability of the emergency rescue team in their rescue duties, such as report and command duties, first aid, rescue, use of emergency facilities, etc.

7.4.6 Observations made during the drills should be recorded to identify deficiencies in the emergency plan for continuous improvement.

8. Information, Instructions, Training and Supervision

8.1 Provision of Information, Instructions and Training

8.1.1 According to section 11 of the F&IU(CS)R, a proprietor or contractor shall provide, to all workers working within a confined space or assisting with such work from immediately outside the confined space, such information, instructions, training and advice as are necessary to ensure the safety and health of all workers in the confined space.

8.1.2 The relevant information or instructions to be given to the workers should be easily comprehensible by the workers or other relevant personnel, taking into account their knowledge and experience. Such information or instructions could be in written form, symbols, diagrams, notices or any other forms as appropriate, so long as they can be clearly understood by the workers and are suitable to the confined space work concerned.

Warning Notice (sample 1)

Warning Notice (sample 2)

8.1.3 The proprietor or contractor should provide adequate and suitable training to all persons involved, directly or indirectly, in confined space work, including:

i. when they are recruited by the proprietor or contractor; and

ii. when they are exposed to new or increased risks due to change of responsibilities, introduction of a new work equipment or a new system of work.

8.1.4 Persons to be trained include workers working in the confined space, safety supervisory personnel, management staff, standby persons, all members of the emergency rescue team and other workers assisting with such work in the immediate vicinity of the confined space, so as to ensure the safety and health of all the persons involved in the activities of the confined space work.

8.1.5 The safety training provided by the proprietor or contractor to confined space workers should include, but not limited to, the following:

i. Induction safety training for all new employees to ensure a thorough safety orientation;

ii. Sufficient information of the confined space should be given to the employees, e.g. the nature of the work to be done, hazards involved and precautionary measures required;

iii. On-the-job safety training for those workers who have received induction safety training. On-the-job safety training should include observation of and participation in the actual work practices or in some simulated working conditions whilst under close supervision;

iv. Training should cover demonstrations and practical exercises. It is particularly important that workers are familiar with both the equipment and procedures;

v. Refresher safety training should be conducted periodically to meet practical needs, and

vi. Re-training should also be provided to workers whose safety performance at work in confined space is found to be unsatisfactory.

8.1.6 Trainings for standby persons and members of the emergency rescue team

The standby persons should be trained on how to maintain communication with the workers inside the confined space and to call for support in case of emergency. Members of the emergency rescue team should be adequately and properly trained in rescue arrangements, emergency procedures, associated risks and correct use of all rescue equipment. They should also be instructed that oxygen gas should not be used to improve oxygen content inside a confined space in all situations. It is recommended that some members of the emergency rescue team should have been trained in first-aid including cardiopulmonary resuscitation.

8.2 Supervision and Safety Management System

8.2.1 To protect the safety and health of workers in confines spaces, the relevant duty holders should implement the safe system of work formulated. Therefore, the proprietor or contractor should provide adequate and necessary information, instructions and trainings to ensure that all persons involved, directly or indirectly, in confined space work, including workers working in a confined space and workers in the vicinity, safety supervisory personnel, management staff, standby persons, all members of the emergency rescue team, to have good understanding and safety awareness of works in confined spaces.

8.2.2 The duty holders should take sufficient and appropriate steps to ensure that all safety precautions stated in the risk assessment report, permit-to-work certificate and method statement are effectively and continuously implemented and maintained. To ensure that all relevant persons are familiar with the emergency procedures, the proprietor or contractor should make emergency preparations for all dangerous situations and drills should be conducted regularly.

8.2.3 Besides, the risk assessment and related work arrangements should be reviewed regularly and at the appropriate time. When there is any circumstance indicating that the risk assessment and/or work arrangement is no longer valid or that the circumstance to which the risk assessment and work arrangement have significant change, the work must be stopped, and workers must all be evacuated immediately with a review to the risk assessment. The risk assessment for confined space work shall be conducted afresh whenever necessary. Unless the working environment is confirmed as safe, no worker should enter the relevant confined space and carry out work.

8.2.4 The proprietor or contractor shall formulate and implement an effective supervision and management system, and assign safety supervisory personnel with sufficient relevant knowledge, experience and safety awareness to supervise the works in confined spaces to ensure the effective implementation of the safe system of work. For example, a tag in/tag out system may be adopted as entry and exit management. It ensures that only appointed certified workers are allowed to work in confined spaces, and the number of workers who have entered the confined space can be obtained.

8.2.5 The level of supervision should be based on the risk assessment results. For the work process with relatively low risk, the duty holders may instruct employees, based on the training they received and their working experience, on how to do their jobs, and then periodically check if all safety precautions are functioning properly. On the other hand, if the risk assessment results indicate that the work process may have a higher risk level, the duty holder shall appoint a suitable person to oversee the operation of the safe system of work, and this person may need to remain on-site to supervise the entire project while the work is in progress.

8.2.6 Duty holders working in confined spaces should consider including specific terms and conditions in outsourced work contracts to enhance supervision and controls over confined space works, including the requirement that proprietors or contractors take video during the entire work period (including entering and exiting confined spaces), and submit the video to the responsible person for the purpose of record and supervision. This arrangement will strengthen the supervision of proprietors, contractors and workers engaged in confined space works.

Taking video during the entire work period (including entering and exiting confined spaces)

Appendix 1

A Sample of Risk Assessment for Confined Space (Drainage Works)

Location of work : _____

Description of work : _____

Main Contractor/Proprietor : _____

Subcontractor (if applicable) : _____

Name of Competent Person : _____ Reference No. of Certificate : _____ Validity Period : _____(Year) _____(Month) _____(Day)

Add a ✓ to appropriate boxes ☐

1.	Contents of Risk Assessment		
1.1	• Work methods to be adopted in the drainage works[1]: _____ • Plant to be used in the drainage works[1]: _____ • Materials to be used in the drainage works[1]: _____		
	Assessment items	**Result(s)**	**Safety Precautions Required**
1.2	Is the drainage works an **underground pipework** as described in section 9(b) of the F&IU(CS)R?	☐ Yes	☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space.
		☐ No (Reasons provided as follows: _____)	
1.3	Is there any **hazardous** gas, vapor, dust or fume, or **deficiency of oxygen** present in the confined space?	☐ Yes	☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space.
		☐ No (Reasons provided as follows: _____)	

[1] The Competent Person should obtain information of work methods, plant and materials to be used for the particular drainage works from the Main Contractor/Subcontractor/Proprietor in order to complete the risk assessment.

	Assessment items	Consequence [2]	Likelihood [2]	Risk [2]	Safety Precautions Required
1.4	**Ingress** of hazardous gas, vapour, dust or fume to the confined space	☐ Very Serious (3) ☐ Serious (2)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	
1.5	Are there any sludge or other deposits being present that are liable to give off hazardous gas, vapour, dust or fume in the confined space?			☐ High risk (>=6)	☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space.
	☐ Yes, **sludge or other deposits** are present in the confined space [3]	☐ Very Serious (3) ☐ Serious (2)	☐ Very likely (3) ☐ Possible (2)	☐ Moderate risk (3-4)	
	☐ No, **sludge or other deposits** are not present in the confined space	(Reasons provided as follows: _____)		☐ Low risk (<=2)	
1.6	**In-rush** into the confined space of free flowing solid or liquid	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	

[2] You may refer to the Risk Assessment Table for the definition of "Consequence", "Likelihood" and "Risk".
[3] Unless the sludge and other deposits are completely removed and purged, otherwise if there are sludge or other deposits present, it is generally very likely or possible for the trapped or dissolved gases such as hydrogen sulphide to be released during drainage work.

1.7	**A fire or explosion** in the confined space	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	
1.8	The **ambient temperature** in the confined space that may lead to loss of consciousness of a certified worker arising from an increase in body temperature	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	
1.9	**Change in the environment** leading to an increased risk of the above hazards during the course of the work in the confined space	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	
1.10	Others (please specify):	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	

1.11	Others (please specify): _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	_____ _____ _____ _____
				☐ Moderate risk (3-4)	_____ _____ _____ _____
				☐ Low risk (<=2)	_____ _____ _____ _____
1.12	• **Period during which certified workers may remain safely in the confined space: _____hour(s)**				
2.	**Safety precautions must be taken when entering and working into the confined space** —— Apart from the aforementioned safety precautions required with respect to the risk assessment, the proprietor or contractor must ensure that all the following safety precautions are taken before allowing certified workers to work in confined spaces				
	☑ Every piece of mechanical equipment in the confined space, which is liable to cause danger, has been disconnected from its power source, with warning notice displayed and its power source locked out;				
	☑ Every pipe or supply line whose contents are liable to create a hazard has been properly blanked off;				
	☑ The confined space has been tested to ensure the absence of any hazardous gas and no deficiency of oxygen;				
	☑ The confined space has been adequately purged and sufficiently cooled and ventilated, having regard to the circumstances of the particular confined space, to ensure that it is a safe workplace;				
	☑ An adequate supply of respirable air and an effective forced ventilation have been provided inside the confined space;				
	☑ Effective steps have been taken to prevent - (i) an ingress to the confined space of hazardous gas, vapour, dust or fume; and (ii) an in-rush into the confined space of free flowing solid or liquid;				
	☑ Formulated appropriate emergency procedures to deal with any serious and imminent danger to workers inside the confined space, including the provision of a sufficient supply of the following items in a satisfactory condition (and keeping them readily available) (a) approved breathing apparatus; (b) suitable apparatus for reviving an unconscious worker; (c) vessels containing oxygen or air; (d) safety harnesses and ropes; and (e) an audio and visual alarm by which the workers inside the confined space can alert those outside.				
	☑ The emergency rescue team is composed of a sufficient number of trained personnel who are ready to carry out emergency procedures in case of accident. All members of the emergency rescue team have been properly and adequately trained in the related emergency rescue procedures, including the details of the emergency rescue plan and full knowledge on how to properly use all the rescue equipment;				
	☑ Instructions, training and advice are provided to all workers within a confined space or assisting with such work from immediately outside the confined space to ensure the safety and health of all workers, including posting up or displaying a clearly visible warning sign in a conspicuous place at the entrance to the confined space, indicating the specified hazards and safety precautions taken in the confined space;				
	☑ All necessary equipment is provided to ensure the safety and health of workers in the confined space, including the provision of suitable gas detectors (i.e. explosion-proof design) for continuous air monitoring if necessary;				
	☑ Only certified workers are allowed to enter or work in the confined space;				
	☑ At least one “Standby Person” is stationed outside the confined space to maintain communication with the workers inside the confined space;				
	☑ The risk assessment report and the permit-to-work certificate should be displayed in a conspicuous place at the entrance of the confined space; and				
	☑ The safety precautions listed above are effective continuously while the workers remain in the confined space.				

	Other safety precautions:

I confirmed that I have at least one year of relevant experience, after obtaining registration as Safety Officer or the certificate as Competent Person, in assessing risk to the safety and health of workers working in confined spaces, and have been appointed by the above-mentioned Main Contractor/ Subcontractor/Proprietor to be the competent person to carry out an assessment in aforesaid drainage works in accordance with section 5(1) of F&IU(CS)R.

I confirmed that, the true to the best of my knowledge and belief, the risk of the working condition in the confined space was assessed according to the requirements of section 5(6) of the F&IU(CS)R, and recommendations of control measures were made under the section with respect to the safety and health of workers working in the confined space.

Signature of the Competent Person
conducted the above risk assessment : _____

Name : _____

Date and time : _____

Receipt of the risk assessment report

Recipient signature : _____

Name : _____

Post : _____

Date and time : _____

Risk Assessment Table

Likelihood / Consequence	Unlikely (1) (Rather remote, though conceivable)	Possible (2) (Event to be expected)	Very likely (3) (Occurs repeatedly)
Very serious (3) Accident causing immediate danger to life or serious bodily injury (Example: gas poisoning, hypoxia, drowning)	**(3) Moderate Risk**	**(6) High Risk**	**(9) High Risk**
Serious (2) Accident causing moderate bodily injury (Example: fracture, skin ulcer, etc.)	**(2) Low Risk**	**(4) Moderate Risk**	**(6) High Risk**
Mild (1) Accident resulting in mild bodily injury (Example: eye irritation from dust, cough)	**(1) Low Risk**	**(2) Low Risk**	**(3) Moderate Risk**

	High Risk
	Moderate Risk
	Low Risk

An Example of Risk Assessment for Confined Space (Drainage Works)

Location of work : Drainage near to exit located at LG3 Carpark of Grade A Industrial Building, Cheng Sha Wan, KLN

Description of work : 2 workers entering the underground drainage to clean the pipeline

Main Contractor/Proprietor : ABC Construction Company Limited

Subcontractor (if applicable) : XYZ Drainage Engineering Ltd

Name of Competent Person : LI, Wai Reference No. of Certificate : CS-123456 Validity Period : 2023 (Year) 2 (Month) 28 (Day)

Add a ✓ to appropriate boxes ☐

1.	**Contents of Risk Assessment**		
1.1	• Work methods to be adopted in the drainage works[1]: Remove the garbage, i.e. plastic bags, metal, etc. out of the drainage. Then clean the pipeline with water • Plant to be used in the drainage works[1]: High pressure water jetrig • Materials to be used in the drainage works[1]: No		
	Assessment items	**Result(s)**	**Safety Precautions Required**
1.2	Is the drainage works an **underground pipework** as described in section 9(b) of the F&IU(CS)R?	☑ Yes	☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space. + Use a blower to direct fresh air through the air duct to the bottom of the confined space to enhance ventilation and reduce the possibility of workers losing consciousness due to increased body temperature. + Workers should carry personal audio and visual alarms.
		☐ No (Reasons provided as follows:)	
1.3	Is there any **hazardous** gas, vapor, dust or fume, or **deficiency of oxygen** present in the confined space?	☑ Yes	☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space. + Sufficient respirable air and effective forced ventilation should be provided continuously in the confined space. + Workers should carry personal audio and visual alarms.
		☐ No (Reasons provided as follows:)	

[1] The Competent Person should obtain information of work methods, plant and materials to be used for the particular drainage works from the Main Contractor/Subcontractor/Proprietor in order to complete the risk assessment.

	Assessment items	Consequence [2]	Likelihood [2]	Risk [2]	Safety Precautions Required
1.4	**Ingress** of hazardous gas, vapour, dust or fume to the confined space	☑ Very Serious (3) ☐ Serious (2)	☐ Very likely (3) ☐ Possible (2) ☑ Unlikely (1)	☐ High risk (>=6)	
				☑ Moderate risk (3-4)	+ The entrance of the confined space is enclosed and guarded by standby person. + Ensure that the related part of the drainage pipe has been suspended for operation. + Workers should carry personal audio and visual alarm. + Examine the connections of the drainage and closed the gate to prevent in-rush of free flowing solid or liquid. + All connected drainage pipes must be properly blanked off.
				☐ Low risk (<=2)	
1.5	Are there any sludge or other deposits being present that are liable to give off hazardous gas, vapour, dust or fume in the confined space?			☑ High risk (>=6)	☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space.
	☑ Yes, **sludge or other deposits** are present in the confined space [3]	☑ Very Serious (3) ☐ Serious (2)	☑ Very likely (3) ☐ Possible (2)	☐ Moderate risk (3-4)	+ Use a blower to direct fresh air through the air duct to the bottom of the confined space to enhance ventilation and remove air impurities. + Workers should carry personal audio and visual alarms.
	☐ No, **sludge or other deposits** are not present in the confined space	(Reasons provided as follows: _____)		☐ Low risk (<=2)	
1.6	**In-rush** into the confined space of free flowing solid or liquid	☑ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☑ Unlikely (1)	☐ High risk (>=6)	
				☑ Moderate risk (3-4)	+ The work should be conducted during non-office hour of the industrial building to avoid in-rush of free flowing liquid. + Enclose the entrance and exit of the drainage and clear all the debris around. + Ensure that the related part of the drainage pipe has been suspended for operation. + Examine the connections of the drainage and close the gate to prevent in-rush of free flowing solid or liquid. + All connected drainage pipes must be properly blanked off. + The entrance of the confined space is enclosed and guarded by standby person. + Check the weather condition and ensure that heavy rain is unlikely to happen at work.
				☐ Low risk (<=2)	

[2] You may refer to the Risk Assessment Table for the definition of "Consequence", "Likelihood" and "Risk".
[3] Unless the sludge and other deposits are completely removed and purged, otherwise if there are sludge or other deposits present, it is generally very likely or possible for the trapped or dissolved gases such as hydrogen sulphide to be released during drainage work.

1.7	**A fire or explosion** in the confined space	☑ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☑ Possible (2) ☐ Unlikely (1)	☑ High risk (>=6)	+ Use a blower to direct fresh air through the air duct to the bottom of the confined space to enhance ventilation and air exchange, and cool the environment. + Ensure that spark is not generated at work. + Ensure that flammable substances are not used at work. + Ensure that excessive heat is not generated when using the high-pressure water jetrig in the process. + Use explosion-proof designed gas detectors to monitor the level of explosive gases (lower explosive limit, LEL) in the confined space continuously until everyone has left the confined space.
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	
1.8	The **ambient temperature** in the confined space that may lead to loss of consciousness of a certified worker arising from an increase in body temperature	☐ Very Serious (3) ☑ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☑ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☑ Moderate risk (3-4)	+ Use a blower to direct fresh air through the air duct to the bottom of the confined space to cool the environment. + Arrange the work to be conducted in cooler periods. + Workers should carry personal audio and visual alarms. + Workers are required to monitor the mental wellbeing of each other, maintain communication with and report personal health condition from time to time to the standby person at work.
				☐ Low risk (<=2)	
1.9	**Change in the environment** leading to an increased risk of the above hazards during the course of the work in the confined space	☐ Very Serious (3) ☑ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☑ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☑ Moderate risk (3-4)	+ Use explosion-proof designed gas detectors to monitor the air in the confined space continuously until everyone has left the confined space. + Workers should carry personal audio and visual alarms. + Workers are required to maintain communication with and report the working condition from time to time to the standby person at work.
				☐ Low risk (<=2)	

1.10	Others (please specify): _____	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	
1.11	Others (please specify): _____	☐ Very Serious (3) ☐ Serious (2) ☐ Mild (1)	☐ Very likely (3) ☐ Possible (2) ☐ Unlikely (1)	☐ High risk (>=6)	
				☐ Moderate risk (3-4)	
				☐ Low risk (<=2)	
1.12	• **Period during which certified workers may remain safely in the confined space:** 2.5 **hour(s)**				
2.	**Safety precautions must be taken when entering and working into the confined space** —— Apart from the aforementioned safety precautions required with respect to the risk assessment, the proprietor or contractor must ensure that all the following safety precautions are taken before allowing certified workers to work in confined spaces				
	☑ Every piece of mechanical equipment in the confined space, which is liable to cause danger, has been disconnected from its power source, with warning notice displayed and its power source locked out;				
	☑ Every pipe or supply line whose contents are liable to create a hazard has been properly blanked off;				
	☑ The confined space has been tested to ensure the absence of any hazardous gas and no deficiency of oxygen;				
	☑ The confined space has been adequately purged and sufficiently cooled and ventilated, having regard to the circumstances of the particular confined space, to ensure that it is a safe workplace;				
	☑ An adequate supply of respirable air and an effective forced ventilation have been provided inside the confined space;				
	☑ Effective steps have been taken to prevent - (i) an ingress to the confined space of hazardous gas, vapour, dust or fume; and (ii) an in-rush into the confined space of free flowing solid or liquid;				
	☑ Formulated appropriate emergency procedures to deal with any serious and imminent danger to workers inside the confined space, including the provision of a sufficient supply of the following items in a satisfactory condition (and keeping them readily available) (a) approved breathing apparatus; (b) suitable apparatus for reviving an unconscious worker; (c) vessels containing oxygen or air; (d) safety harnesses and ropes; and (e) an audio and visual alarm by which the workers inside the confined space can alert those outside.				
	☑ The emergency rescue team is composed of a sufficient number of trained personnel who are ready to carry out emergency procedures in case of accident. All members of the emergency rescue team have been properly and adequately trained in the related emergency rescue procedures, including the details of the emergency rescue plan and full knowledge on how to properly use all the rescue equipment;				
	☑ Instructions, training and advice are provided to all workers within a confined space or assisting with such work from immediately outside the confined space to ensure the safety and health of all workers, including posting up or displaying a clearly visible warning sign in a conspicuous place at the entrance to the confined space, indicating the specified hazards and safety precautions taken in the confined space;				

	☑ All necessary equipment is provided to ensure the safety and health of workers in the confined space, including the provision of suitable gas detectors (i.e. explosion-proof design) for continuous air monitoring if necessary;
	☑ Only certified workers are allowed to enter or work in the confined space;
	☑ At least one "Standby Person" is stationed outside the confined space to maintain communication with the workers inside the confined space;
	☑ The risk assessment report and the permit-to-work certificate should be displayed in a conspicuous place at the entrance of the confined space; and
	☑ The safety precautions listed above are effective continuously while the workers remain in the confined space.
	Other safety precautions:

I confirmed that I have at least one year of relevant experience, after obtaining registration as Safety Officer or the certificate as Competent Person, in assessing risk to the safety and health of workers working in confined spaces, and have been appointed by the above-mentioned Main Contractor/ Subcontractor/Proprietor to be the competent person to carry out an assessment in aforesaid drainage works in accordance with section 5(1) of F&IU(CS)R.

I confirmed that, the true to the best of my knowledge and belief, the risk of the working condition in the confined space was assessed according to the requirements of section 5(6) of the F&IU(CS)R, and recommendations of control measures were made under the section with respect to the safety and health of workers working in the confined space.

Signature of the Competent Person conducted the above risk assessment : _____

Name : LI, Wai (XYZ Drainage Engineering Ltd)

Date and time : 13/06/2022 14:30

Receipt of the risk assessment report

Recipient signature : _____

Name : HUNG, Chi Ping

Post : Project Manager (ABC Construction Company Limited)

Date and time : 13/06/2022 15:00

Risk Assessment Table

Likelihood / Consequence	**Unlikely (1)** (Rather remote, though conceivable)	**Possible (2)** (Event to be expected)	**Very likely (3)** (Occurs repeatedly)
Very serious (3) Accident causing immediate danger to life or serious bodily injury (Example: gas poisoning, hypoxia, drowning)	**(3) Moderate Risk**	**(6) High Risk**	**(9) High Risk**
Serious (2) Accident causing moderate bodily injury (Example: fracture, skin ulcer, etc.)	**(2) Low Risk**	**(4) Moderate Risk**	**(6) High Risk**
Mild (1) Accident resulting in mild bodily injury (Example: eye irritation from dust, cough)	**(1) Low Risk**	**(2) Low Risk**	**(3) Moderate Risk**

	High Risk
	Moderate Risk
	Low Risk

Appendix 3

A Sample of "Permit-to-work Certificate" for Entry into Confined Space (Drainage Works)

Location of work : _____

Description of work : _____

Main Contractor/Proprietor : _____

Name of the competent person appointed : _____

Date of risk assessment : _____

Date for entry to the confined space : _____ (Year) _____ (Month) _____ (Day)

Time for entry to the confined space : From _____ *am/pm

This permit-to-work certificate is valid until : _____ (Y) _____ (M) _____ (D) _____ *am/pm (Time)

Add a ✓ to appropriate boxes □

Workers				
1.1	Certified Worker			
	Maximum duration that certified workers are allowed to stay in the confined space : _____ Hour(s)			
	Name	Reference No. of Certificate	Validity Period	Signature
i.e.:	CHAN, Tai Man	CSCW10010102	29/02/2024	
1.2	Standby Person			
	Name	Date of training	Responsibility	Signature
			✓ Maintain communication with the workers inside the confined space, and call for support in case of emergency; ✓ Brief the rescue personnel of the relevant circumstances of the incident upon their arrival in case of emergency; ✓ Even in case of emergency, the standby person should not enter the confined space.	
1.3	Onsite Rescue Personnel			
	Name	Date received training for the rescue and emergency procedures	Responsibility	Signature
			✓ Familiar with the details of the emergency rescue plan; ✓ Know how to properly operate all rescue equipment provided.	

1.4	Underground Pipework
	☐ The drainage works are **underground pipework** as described in section 9(b) of the F&IU(CS)R, and therefore Contractor/Proprietor has to ☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space; and _____ _____ _____ ☐ The drainage works are **NOT underground pipework** as described in section 9(b) of the F&IU(CS)R with the reason(s) stated as follows: _____ _____ _____ **Remarks：Must choose one out of the two options above**

1.5 The following safety precautions have been taken as recommended in the risk assessment report prepared by the competent person

☐ Has verified that such risk assessment report covers all matters referred to in section 5(2) of F&IU(CS)R;

☐ The risk assessment report has been displayed in a conspicuous place at the entrance of the confined space. The following safety precautions have been taken according to the recommendations of the risk assessment report;

☐ The drainage works are underground pipework as described in section 9(b) of the F&IU(CS)R. It must be ensured that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; (ii) wearing a suitable safety harness connected to a lifeline; and appropriate gas detectors (i.e. explosion-proof design) are used to monitor the air in the confined space continuously until everyone has left the confined space; and _____

_____

☐ There is hazardous gas, vapor, dust or fume, or deficiency of oxygen present in the confined space. It must be ensured that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; (ii) wearing a suitable safety harness connected to a lifeline; and appropriate gas detectors (i.e. explosion-proof design) are used to monitor the air in the confined space continuously until everyone has left the confined space; and _____

_____

☐ The risk of ingress of hazardous gas, vapour, dust or fume to the confined space is from **MODERATE TO HIGH**. Appropriate steps should be taken to prevent the ingress of hazardous materials to the confined space. In addition, control measures taken are as follows: _____

_____

_____

☐ There are sludge or other deposits present in this confined space, which result in **MODERATE TO HIGH** risk of giving off hazardous gas, vapor, dust or fume. It must be ensured that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; (ii) wearing a suitable safety harness connected to a lifeline; and appropriate gas detectors (i.e. explosion-proof design) are used to monitor the air in the confined space continuously until everyone has left the confined space; and _____

_____

☐ The risk of in-rush of free flowing solid or liquid to the confined space, which leads to drowning, asphyxiation or inability to reach a respirable environment of workers, is from **MODERATE TO HIGH**. Appropriate steps should be taken to prevent the in-rush of free flowing solid or liquid to the confined space. In addition, control measures taken are as follows: _____

_____

☐ The risk of fire or explosion resulting in serious injury due to the presence of flammable, explosive or oxygen enriched atmosphere in the confined space is from **MODERATE TO HIGH**. Effective forced ventilation should be continuously maintained in the confined space. In addition, control measures taken are as follows: _____

_____

_____

☐ The risk of loss of consciousness of a certified worker arising from an increase in body temperature in the confined space is from **MODERATE TO HIGH**. Effective forced ventilation should be continuously maintained in the confined space. In addition, control measures taken are as follows:_____

_____

_____

☐ The risk of the change in environment during the work process resulting in increased risk of the above hazards in the confined space is from **MODERATE TO HIGH**. It must be ensured that the persons entering or remaining in the confined space are using appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space. In addition, control measures taken are as follows: _____

_____

_____

☐ The use of generators, fuel-driven tools, adhesives, paints, volatile or flammable solvents, etc. in a confined space may cause additional hazards. The recommendations in the risk assessment report should be followed and the control measures are taken as follows: _____

_____

☐	Other safety measures (please specify):
☐	
☐	

Atmospheric Test

- ■ Testing Date : _____ (Y) _____(M) _____(D)
- ■ Testing Time : _____(Hour) _____(Min) *am/pm
- ■ Model of gas detector : _____
- ■ S/N of gas detector : _____
- ■ Calibration expiry date : _____ (Y) _____(M) _____(D)

Testing Results (Location: _____)

- ☐ H_2S : _____ ppm
- ☐ CO : _____ ppm
- ☐ O_2 : _____ %
- ☐ LEL(Percentage) : _____ %

Testing Results (Location: _____)

- ☐ H_2S : _____ ppm
- ☐ CO : _____ ppm
- ☐ O_2 : _____ %
- ☐ LEL(Percentage) : _____ %

Testing Results (Location: _____)

- ☐ H_2S : _____ ppm
- ☐ CO : _____ ppm
- ☐ O_2 : _____ %
- ☐ LEL(Percentage) : _____ %

☐ After the atmospheric test, I confirm that there is no hazardous gas and no oxygen-deficient situation in this confined space.

Responsible person conducted the atmospheric test : _____

Signature : _____

Safety Precautions for Entry into the Confined Space

- ☐ Every piece of mechanical equipment in the confined space, which is liable to cause danger, has been disconnected from its power source, with warning notice displayed and its power source locked out;
- ☐ Every pipe or supply line whose contents are liable to create a hazard has been properly blanked off;
- ☐ The confined space has been tested to ensure the absence of any hazardous gas and no deficiency of oxygen;
- ☐ The confined space has been adequately purged and sufficiently cooled and ventilated, having regard to the circumstances of the particular confined space, to ensure that it is a safe workplace;
- ☐ An adequate supply of respirable air and an effective forced ventilation have been provided inside the confined space;
- ☐ Effective steps have been taken to prevent - (i) an ingress to the confined space of hazardous gas, vapour, dust or fume; and (ii) an in-rush into the confined space of free flowing solid or liquid
- ☐ Formulated appropriate emergency procedures to deal with any serious and imminent danger to workers inside the confined space, including the provision of a sufficient supply of the following items in a satisfactory condition (and keeping them readily available)
  - (a) approved breathing apparatus;
  - (b) suitable apparatus for reviving an unconscious worker;
  - (c) vessels containing oxygen or air;
  - (d) safety harnesses and ropes; and
  - (e) an audio and visual alarm by which the workers inside the confined space can alert those outside.
- ☐ The emergency rescue team is composed of a sufficient number of trained personnel who are ready to carry out emergency procedures in case of accident. All members of the emergency rescue team have been properly and adequately trained in the related emergency rescue procedures, including the details of the emergency rescue plan and full knowledge on how to properly use all the rescue equipment;
- ☐ Instructions, training and advice are provided to all workers within a confined space or assisting with such work from immediately outside the confined space to ensure the safety and health of all workers, including posting up or displaying a clearly visible warning sign in a conspicuous place at the entrance to the confined space, indicating the specified hazards and safety precautions taken in the confined space;
- ☐ All necessary equipment is provided to ensure the safety and health of workers in the confined space, including the provision of suitable gas detectors (i.e. explosion-proof design) for continuous air monitoring if necessary;
- ☐ Only certified worker is allowed to enter or work in the confined space;
- ☐ At least one "Standby Person" is stationed outside the confined space to maintain communication with the workers inside the confined space;
- ☐ The risk assessment report and this permit-to-work certificate should be displayed in a conspicuous place at the entrance of the confined space; and
- ☐ The safety precautions listed above are effective continuously while the workers remain in the confined space.

Emergency rescue equipment provided

☐ Approved breathing apparatus : _____set

☐ Apparatus for reviving an unconscious worker : _____set

☐ Vessels containing oxygen or air : _____set

☐ Safety harnesses and ropes : _____set

☐ Audio and visual alarm by which the workers inside the confined space can alert those outside : _____set

☐ Other relevant emergency rescue equipment, including : ☐ Tripods and winches; ☐ _____

☐ I confirm that the above emergency rescue equipment is sufficient with satisfactory condition and are readily available.

List of protective equipment provided

General

☐ Forced ventilation device : _____set

☐ Continuous atmospheric monitoring equipment : _____set

☐ Walkie-talkie (explosion-proof design) :_____set

☐ Shields :_____set

☐ Lighting device : _____set

☐ Others (Please specify) : _____

Personal Protective Equipment

☐ Approved breathing apparatus : _____set (excluding for emergency use)

☐ Audio and visual alarm : _____set

☐ Protective clothing : _____piece

☐ Head, Hand & Foot Protection : _____piece

☐ Life Lines & Harness : _____set

☐ Eye Protection : _____set

☐ Ear Protection : _____set

☐ Others (Please specify) : _____

Declaration by the proprietor/contractor or authorised representative

Permit-to-work Certificate

I am the **proprietor/contractor/authorized representative*** of the confined space work mentioned above. I confirmed that all the required safety precautions have been taken in accordance with the risk assessment report conducted by the competent person, and then I issued this permit-to-work certificate accordingly.

Signature : _____

Name : _____

Post : _____

Date and Time : _____

* Please delete if not applicable

Receipt of Permit-to-work Certificate

(To be filled by the work supervisor or person in-charge)

I confirmed that I have read and understood the content of the certificate, and shall undertake to work in accordance with all the conditions laid down in the certificate.

Signature : _____

Name : _____

Post : _____

Date and Time : _____

Proof of Completion

(To be filled by the work supervisor or person in-charge)

I confirm that the confined space work mentioned above has been completed and that all assigned persons, materials and equipment have been withdrawn from the site, and I hereby sign to confirm.

Signature : _____

Name : _____

Post : _____

Date and Time : _____

Cancellation of Permit-to-work Certificate

I am the **proprietor/contractor/authorized representative*** of the confined space work mentioned above. I hereby cancelled the permit-to-work certificate. I understand that a new permit-to-work certificate will be required if work is to be continued.

Signature : _____

Name : _____

Post : _____

Date and Time : _____

* Please delete if not applicable

An Example of "Permit-to-work Certificate" for Entry into Confined Space (Drainage Works)

Location of work : Drainage near to exit located at LG3 Carpark of Grade A Industrial Building, Cheng Sha Wan, KLN

Description of work : 2 workers entering the underground drainage to clean the pipeline

Main Contractor/Proprietor : ABC Construction Company Limited

Name of the competent person appointed: : LI, Wai

Date of risk assessment : 13/6/2022

Date for entry to the confined space : 2022 (Year) 6 (Month) 15 (Day)

Time for entry to the confined space : From 8:30 *~~am~~/pm

This permit-to-work certificate is valid until : 2022 (Y) 6 (M) 15 (D) 11:00 *~~am~~/pm (Time)

Add a ✓ to appropriate boxes □

Workers				
1.1	Certified Worker			
	Maximum duration that certified workers are allowed to stay in the confined space : 2.5 Hour(s)			
	Name	Reference No. of Certificate	Validity Period	Signature
i.e.:	CHAN, Tai Man	CSCW10010102	29/02/2024	
1	CHEUNG, Yik Chun	CS-1006001	23/7/2023	
2	YUEN, Tai Chiu	CSCW10055601	30/12/2023	
1.2	Standby Person			
	Name	Date of training	Responsibility	Signature
1	CHAN, Kau	1/7/2022	✓ Maintain communication with the workers inside the confined space, and call for support in case of emergency; ✓ Brief the rescue personnel of the relevant circumstances of the incident upon their arrival in case of emergency; ✓ Even in case of emergency, the standby person should not enter the confined space.	
1.3	Onsite Rescue Personnel			
	Name	Date received training for the rescue and emergency procedures	Responsibility	Signature
1	LI, Chi On	13/6/2022	✓ Familiar with the details of the emergency rescue plan; ✓ Know how to properly operate all rescue equipment provided.	

1.4	Underground Pipework
	☑ The drainage works are **underground pipework** as described in section 9(b) of the F&IU(CS)R, and therefore Contractor/Proprietor has to ☑ Ensure that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; and (ii) wearing a suitable safety harness connected to a lifeline. ☑ Use appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space; and + Use a blower to direct fresh air through the air duct to the bottom of the confined space to enhance ventilation and reduce the possibility of workers losing consciousness due to increased body temperature; and + Workers should carry personal audio and visual alarms. ☐ The drainage works are **NOT underground pipework** as described in section 9(b) of the F&IU(CS)R with the reason(s) stated as follows: _____ _____ _____ **Remarks：Must choose one out of the two options above**

1.5 The following safety precautions have been taken as recommended in the risk assessment report prepared by the competent person

☑ Has verified that such risk assessment report covers all matters referred to in section 5(2) of F&IU(CS)R;

☑ The risk assessment report has been displayed in a conspicuous place at the entrance of the confined space. The following safety precautions have been taken according to the recommendations of the risk assessment report;

☑ The drainage works are underground pipework as described in section 9(b) of the F&IU(CS)R. It must be ensured that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; (ii) wearing a suitable safety harness connected to a lifeline; and appropriate gas detectors (i.e. explosion-proof design) are used to monitor the air in the confined space continuously until everyone has left the confined space; and (i) use a blower to direct fresh air through the air duct to the bottom of the confined space to enhance ventilation and reduce the possibility of workers losing consciousness due to increased body temperature; (ii) workers should carry personal audio and visual alarms;

☑ There is hazardous gas, vapor, dust or fume, or deficiency of oxygen present in the confined space. It must be ensured that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; (ii) wearing a suitable safety harness connected to a lifeline; and appropriate gas detectors (i.e. explosion-proof design) are used to monitor the air in the confined space continuously until everyone has left the confined space; and (i) sufficient respirable air and effective forced ventilation should be provided continuously in the confined space; (ii) workers should carry personal audio and visual alarms;

☑ The risk of ingress of hazardous gas, vapour, dust or fume to the confined space is from **MODERATE TO HIGH**. Appropriate steps should be taken to prevent the ingress of hazardous materials to the confined space. In addition, control measures taken are as follows: (i) The entrance of the confined space is enclosed and guarded by standby person; (ii)Ensure that the related part of the drainage pipe has been suspended for operation; (iii) Workers should carry personal audio and visual alarms; (iv) Examine the connections of the drainage and close the gate to prevent in-rush of free flowing solid or liquid; (v) all connected drainage pipes must be properly blanked off;

☑ There are sludge or other deposits present in this confined space, which result in **MODERATE TO HIGH** risk of giving off hazardous gas, vapor, dust or fume. It must be ensured that any person entering or remaining in that particular confined space is properly (i) wearing a suitable approved breathing apparatus; (ii) wearing a suitable safety harness connected to a lifeline; and appropriate gas detectors (i.e. explosion-proof design) are used to monitor the air in the confined space continuously until everyone has left the confined space; and (i) Use a blower to direct fresh air through the air duct to the bottom of the confined space to enhance ventilation and remove the air impurities; (ii) Workers should carry personal audio and visual alarms;

☑ The risk of in-rush of free flowing solid or liquid to the confined space, which leads to drowning, asphyxiation or inability to reach a respirable environment of workers, is from **MODERATE TO HIGH**. Appropriate steps should be taken to prevent the in-rush of free flowing solid or liquid to the confined space. In addition, control measures taken are as follows: (i) The work should be conducted during non-office hour of the industrial building to avoid in-rush of free flowing solid or liquid; (ii) Enclose the entrance and exit of the drainage and clear all the debris around; (iii) Ensure that the related part of the drainage pipe has been suspended for operation; (iv) Examine the connections of the drainage and closed the gate to prevent in-rush of free flowing solid or liquid; (v) All connected drainage pipes must be properly blanked off; (vi) The entrance of the confined space is enclosed and guarded by standby person; (vii) Check the weather condition and ensure that heavy rain is unlikely to happen at work;

☑ The risk of fire or explosion resulting in serious injury due to the presence of flammable, explosive or oxygen enriched atmosphere in the confined space is from **MODERATE TO HIGH**. Effective forced ventilation should be continuously maintained in the confined space. In addition, control measures taken are as follows: (i) Use a blower to direct fresh air through the air duct to the bottom of the confined space to enhance ventilation and air exchange, and cool the environment; (ii) Ensure that sparks is not generated at work; (iii) Ensure that flammable substances are not used at work; (iv) Ensure that excessive heat is not generated when using the high pressure water jetrig process; (v) Use explosion-proof designed gas detectors to monitor the level of explosive gases in the confined space continuously until everyone has left the confined space;

☑ The risk of loss of consciousness of a certified worker arising from an increase in body temperature in the confined space is from **MODERATE TO HIGH**. Effective forced ventilation should be continuously maintained in the confined space. In addition, control measures taken are as follows: (i) Use a blower to direct fresh air through the air duct to the bottom of the confined space to cool the environment; (ii) Arrange the work to be conducted in cooler periods; (iii) Workers should carry personal audio and visual alarms; (iv) Workers are required to monitor the mental wellbeing of each other, maintain communication with and report personal health condition from time to time to the standby person at work;

☑ The risk of the change in environment during the work process resulting in increased risk of the above hazards in the confined space is from **MODERATE TO HIGH**. It must be ensured that the persons entering or remaining in the confined space are using appropriate gas detectors (i.e. explosion-proof design) to monitor the air in the confined space continuously until everyone has left the confined space. In addition, control measures taken are as follows: (i) Workers should carry personal audio and visual alarms; (ii) Workers are required to maintain communication with and report the working condition from time to time to the standby person at work;

☐ The use of generators, fuel-driven tools, adhesives, paints, volatile or flammable solvents, etc. in a confined space may cause additional hazards. The recommendations in the risk assessment report should be followed and the control measures are taken as follows: _____

☐	Other safety measures (please specify):
☐	
☐	

Atmospheric Test

- ■ Testing Date : 2022 (Y) 6 (M) 15 (D)
- ■ Testing Time : 8 (Hour) 0 (Min) *am/pm
- ■ Model of gas detector : GAS-AIR
- ■ S/N of gas detector : G009801
- ■ Calibration expiry date : 2023 (Y) 3 (M) 15 (D)

Testing Results (Location: Top; 0.2m depth **)**

- ☑ H_2S : 1 ppm
- ☑ CO : 3 ppm
- ☑ O_2 : 20.8 %
- ☑ LEL(Percentage) : 1.0 %

Testing Results (Location: Middle; 1.2m depth **)**

- ☑ H_2S : 2 ppm
- ☑ CO : 0 ppm
- ☑ O_2 : 20.9 %
- ☑ LEL(Percentage) : 0.0 %

Testing Results (Location: Bottom; 2.2m depth **)**

- ☑ H_2S : 3 ppm
- ☑ CO : 0 ppm
- ☑ O_2 : 20.5 %
- ☑ LEL(Percentage) : 1.0 %

☐ After the atmospheric test, I confirm that there is no hazardous gas and no oxygen-deficient situation in this confined space.

Responsible person conducted the atmospheric test : LI, Wai

Signature : 

Safety Precautions for Entry into the Confined Space

- ☑ Every piece of mechanical equipment in the confined space, which is liable to cause danger, has been disconnected from its power source, with warning notice displayed and its power source locked out;
- ☑ Every pipe or supply line whose contents are liable to create a hazard has been properly blanked off;
- ☑ The confined space has been tested to ensure the absence of any hazardous gas and no deficiency of oxygen;
- ☑ The confined space has been adequately purged and sufficiently cooled and ventilated, having regard to the circumstances of the particular confined space, to ensure that it is a safe workplace;
- ☑ An adequate supply of respirable air and an effective forced ventilation have been provided inside the confined space;
- ☑ Effective steps have been taken to prevent - (i) an ingress to the confined space of hazardous gas, vapour, dust or fume; and (ii) an in-rush into the confined space of free flowing solid or liquid
- ☑ Formulated appropriate emergency procedures to deal with any serious and imminent danger to workers inside the confined space, including the provision of a sufficient supply of the following items in a satisfactory condition (and keeping them readily available)
  - (a) approved breathing apparatus;
  - (b) suitable apparatus for reviving an unconscious worker;
  - (c) vessels containing oxygen or air;
  - (d) safety harnesses and ropes; and
  - (e) an audio and visual alarm by which the workers inside the confined space can alert those outside.
- ☑ The emergency rescue team is composed of a sufficient number of trained personnel who are ready to carry out emergency procedures in case of accident. All members of the emergency rescue team have been properly and adequately trained in the related emergency rescue procedures, including the details of the emergency rescue plan and full knowledge on how to properly use all the rescue equipment;
- ☑ Instructions, training and advice are provided to all workers within a confined space or assisting with such work from immediately outside the confined space to ensure the safety and health of all workers, including posting up or displaying a clearly visible warning sign in a conspicuous place at the entrance to the confined space, indicating the specified hazards and safety precautions taken in the confined space;
- ☑ All necessary equipment is provided to ensure the safety and health of workers in the confined space, including the provision of suitable gas detectors (i.e. explosion-proof design) for continuous air monitoring if necessary;
- ☑ Only certified worker is allowed to enter or work in the confined space;
- ☑ At least one "Standby Person" is stationed outside the confined space to maintain communication with the workers inside the confined space;
- ☑ The risk assessment report and this permit-to-work certificate should be displayed in a conspicuous place at the entrance of the confined space; and
- ☑ The safety precautions listed above are effective continuously while the workers remain in the confined space.

Emergency rescue equipment provided

☑ Approved breathing apparatus : 2 sets
☑ Apparatus for reviving an unconscious worker : 1 set
☑ Vessels containing oxygen or air : 2 sets
☑ Safety harnesses and ropes : 2 sets
☑ Audio and visual alarm by which the workers inside the confined space can alert those outside : 2 sets
☑ Other relevant emergency rescue equipment, including : ☑ Tripods and winches; ☐ _____

☑ I confirm that the above emergency rescue equipment is sufficient with satisfactory condition and are readily available.

List of protective equipment provided

General

☑ Forced ventilation device : 1 set
☑ Continuous atmospheric monitoring equipment : 1 set
☑ Walkie-talkie (explosion-proof design) : 2 sets
☐ Shields : _____ set
☑ Lighting device : 2 sets
☐ Others (Please specify) : _____

Personal Protective Equipment

☑ Approved breathing apparatus : 2 sets (excluding for emergency use)
☑ Audio and visual alarm : 2 sets
☑ Protective clothing : 4 pieces
☑ Head, Hand & Foot Protection : 3 pieces
☑ Life Lines & Harness : 2 sets
☑ Eye Protection : 3 sets
☑ Ear Protection : 3 sets
☐ Others (Please specify) : _____

Declaration by the proprietor/contractor or authorised representative

Permit-to-work Certificate

I am the **proprietor/contractor/~~authorized representative~~*** of the confined space work mentioned above. I confirmed that all the required safety precautions have been taken in accordance with the risk assessment report conducted by the competent person, and then I issued this permit-to-work certificate accordingly.

Signature : _____

Name : HUNG, Chi Ping

Post : Project Manager (ABC Construction Company Limited)

Date and Time : 15/6/2022 8:15pm

* Please delete if not applicable

Receipt of Permit-to-work Certificate

(To be filled by the work supervisor or person in-charge)

I confirmed that I have read and understood the content of the certificate, and shall undertake to work in accordance with all the conditions laid down in the certificate.

Signature : 

Name : CHAN, Kau

Post : Supervisor (XYZ Drainage Engineering Ltd)

Date and Time : 15/6/2022 8:15pm

Proof of Completion

(To be filled by the work supervisor or person in-charge)

I confirm that the confined space work mentioned above has been completed and that all assigned persons, materials and equipment have been withdrawn from the site, and I hereby sign to confirm.

Signature : 

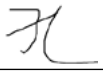
Name : CHAN, Kau

Post : Supervisor (XYZ Drainage Engineering Ltd)

Date and Time : 15/6/2022 10:30pm

Cancellation of Permit-to-work Certificate

I am the **proprietor/contractor/~~authorized representative~~*** of the confined space work mentioned above. I hereby cancelled the permit-to-work certificate. I understand that a new permit-to-work certificate will be required if work is to be continued.

Signature : 

Name : HUNG, Chi Ping

Post : Project Manager (ABC Construction Company Limited)

Date and Time : 15/6/2022 10:30pm

* Please delete if not applicable

9. List of References

1. Occupational Safety and Health Ordinance, Chapter 509
2. Occupational Safety and Health Regulation, Chapter 509A
3. Factories and Industrial Undertakings Ordinance, Chapter 59
4. Factories and Industrial Undertakings Regulations, Chapter 59A
5. Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, Chapter 59Z
6. Factories and Industrial Undertakings (Confined Spaces) Regulation, Chapter 59AE
7. Code of Practice - Safety and Health at Work in Confined Spaces, Labour Department
8. A Brief Guide to the Factories and Industrial Undertakings (Confined Spaces) Regulation, Labour Department
9. Safe Work in Confined Spaces, Labour Department
10. Safety Guide for Work in Manholes, Labour Department
11. Risk Assessment for the Prevention of Heat Stroke at Work, Labour Department
12. Prevention of Heat Stroke at Work in a Hot Environment, Labour Department
13. Air Monitoring in the Workplace, Labour Department
14. Code of Practice on Control of Air Impurities (Chemical Substances) in the Workplace, Labour Department
15. List of Approved Breathing Apparatuses under the Factories and Industrial Undertakings (Confined Spaces) Regulation (https://www.labour.gov.hk/eng/faq/pdf/BreathApparatus.pdf)
16. Approved Code of Practice and Guidance– Safe Work in Confined Spaces (Third edition, 2014 L101), the Health and Safety Executive, UK
17. Technical Advisory on Work Safely in Confined Spaces, WSH Council, 2010, Singapore
18. Avoiding Danger from Underground Services (Third edition, 2014 HSG47), the Health and Safety Executive, UK

10. Enquiries and Complaints

Enquiries

If you wish to enquire about this Guidance Notes or require advice on occupational safety and health matters, please contact the Occupational Safety and Health Branch of the Labour Department through:

Telephone : 2559 2297 (auto-recording service available outside office hours)

Fax : 2915 1410

Email : enquiry@labour.gov.hk

Information on the services offered by the Labour Department and on major labour legislation is also available on our website at http://www.labour.gov.hk. For details on the services offered by the Occupational Safety and Health Council, please call 2739 9000.

Complaints

If you have any complaints about unsafe workplace operations and environments, please call the LD's OSH complaint hotline at 2542 2172, or fill out and submit an online OSH complaint form on our website. All complaints will be treated in the strictest confidence.

Online OSH complaint Form

published by the Labour Department

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