CIVILSAFETY
SAFETY AND TRAINING

MSMWHS217 Gas test atmospheres

Learner Guide

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Version No#	Review Date	Date Updated	Validation Date	Validation Team	Details of Updates
1.0	25/05/2018	25/05/2017	/ /		Document created
	/ /	/ /	/ /		
	/ /	/ /	/ /		
	/ /	/ /	/ /		

Note: please change Version number and date on each document to reflect the Version Plate.

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Gas Test Atmosphere

Introduction

This course is based on the unit of competency **MSMWHS217: Gas Test Atmospheres.**

This unit covers the testing of working atmosphere to determine if it is safe for the proposed work. Testing could include the use of electronic test apparatus.

The materials in this unit cover the activities involved in:

- Determining the need for testing.
- Selecting and calibrating equipment.
- Reading and interpreting the test results.
- Communicating testing results and interpretations.
- Cleaning, storing and maintaining testing equipment.

Testing equipment specifics will need to be covered in the workplace due to the variety of equipment available.

Gas Testing Safety Information

Your organisation will have access to, and will have applied the relevant safety information in order to keep all people safe in all operational situations.

Relevant safety information can come from:

- Legislation.
- Australian standards.
- Manufacturer's specifications and instructions.
- Organisational procedures and policies.

Organisational Procedures and Policies

- Risk management processes and procedures.
- Permit entry plans.
- Testing, measuring and monitoring plans.
- Rescue and first aid plans and procedures.

Prior to conducting gas testing, ensure that you are familiar with all safety requirements and procedures that apply to the task.

Organisational procedures and policies that support safety could include:

- Safe working procedures or Standard Operating Procedures (SOPs).
- Work instructions, permanent or temporary.
- Pre-entry testing procedures, post-entry testing procedures and post-exit testing procedures.

Standard Operating Procedures

Standard Operating Procedures (SOP) must be followed at all times. SOPs cover such areas as:

- Recognising and preventing hazards.
- Carrying out work in confined spaces.
- Working in proximity to others.
- Worksite visitors and the public.

Emergency Response

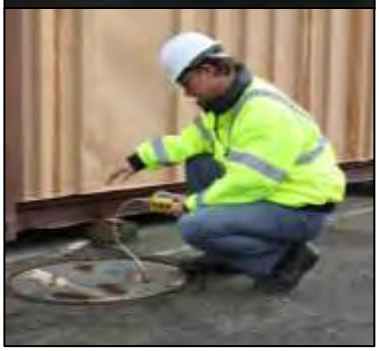
DIAL 000

It is important to stay calm and focused in a crisis. The quicker and more effectively all personnel/workers can react in an emergency, the better the outcome. Raise the alarm at once if there is an emergency. If all procedures, equipment and personnel/workers are prepared, a rescue can be attempted without delay.

It may be necessary for a trained person to apply first aid. Emergency services may need to be telephoned.

Incidents, fire and accidents must be reported to the proper authorities, your supervisors and completion of forms and documents must be done after the event. Always follow your company's emergency response policies and procedures.

Determine Atmosphere to be Tested



Atmospheric readings are taken when it is suspected that atmospheric conditions may incapacitate or injure a person, or when exposure to the atmosphere may lead to illness or death.

These conditions are most likely to develop in confined spaces where the contaminants in the air are unable to escape or be diluted.

If there is any doubt about the safe completion of tasks and activities due to atmospheric conditions, it is necessary to test for the level of oxygen, atmospheric contaminants and any flammable gas or vapour present.

Testing the atmosphere in a confined space for gases is a routine part of the risk management process. Testing needs to be carried out by a competent person using a suitable, correctly calibrated gas detector.

Where relevant, the atmosphere in a confined space needs to be tested for:

- Oxygen content.
- Airborne concentration of flammable contaminants.
- Airborne concentration of potentially harmful contaminants (e.g. hydrogen sulphide, carbon monoxide and methylene chloride).

Testing and Work Permits

Entry to some areas is determined and monitored through the use of work permits. The issuing of and complying with work permits can involve testing the spaces and atmospheres to be worked in.

Testing for the Issuing of Work Permits

If you are responsible for the issuing of work permits then it may be necessary to conduct atmospheric testing. The results may be used to determine:

- The type of permit required.
- PPE requirements, e.g. breathing apparatus, masks.
- The requirements for atmosphere testing to be carried out as part of the permitted work.

Testing to Comply with Work Permits

Some work permits state the requirement for atmospheric testing prior to any activities or tasks starting.

You may need to test atmospheres for contaminants, in a number of situations before any work can begin. These include:

- Confined spaces or open areas.
- Enclosed and partially enclosed spaces.
- Storage tanks, silos, pits, pipes, shafts, ducts, transport vehicles and ships.

Some work permits require the atmosphere to be tested prior to, during or at the completion of the activities; these requirements will be listed on the permit.

Hazardous Atmospheres

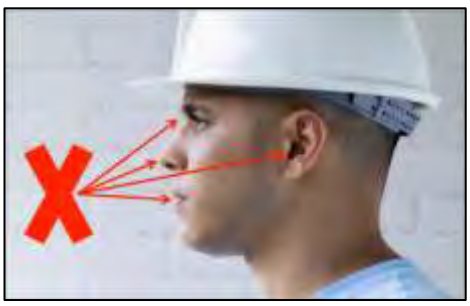
Some of the hazardous atmospheres that must be tested to ensure safe levels are:

Atmosphere Type	Description
Combustible/Flammable Atmospheres	Combustible or flammable atmospheres are those that contain enough flammable gases and oxygen to support a fire or cause an explosion.
Toxic Atmospheres	Toxic atmospheres are those where any substances are present in high enough concentrations to cause illness, injury or death.
Irritant/Corrosive Atmospheres	Irritant or corrosive atmospheres are either primary or secondary. ➢ Primary irritants have limited effects on the entire system or body. ➢ A secondary irritant atmosphere could have systemic effects on the body.
Asphyxiating Atmospheres	Asphyxiating atmospheres are where oxygen is below concentration levels capable of supporting life (oxygen levels between 19.5% and 23.5% are considered safe).

Safe Atmospheres

A safe atmosphere must be ensured during work in a confined space. A safe atmosphere in a confined space is one that:

- Has a safe oxygen level.
- Is free of atmospheric contaminants or contains atmospheric contaminants below their exposure standard (if any).
- Has any flammable gas or vapour in the atmosphere below 5% of its Lower Explosive Limit (LEL).



A person's senses should never be used to determine if the air in a confined space is safe. Many toxic or flammable gases cannot be seen or smelt and the level of oxygen in the air cannot be determined using one's senses.

Explosive Range

The Explosive Range is the range of concentrations where a substance may be explosive. This range will vary depending upon the type of gas or substance.

Different substances will need concentration levels in a determined range to become explosive. If the level is higher than the designated range, referred to as the Upper Explosive Limit (UEL), or lower than the designated range, the Lower Explosive Limit (LEL), the explosive range has been breached.

Upper Explosive Limit (UEL)	The UEL is the concentration of flammable gas or vapour in the air, above which an explosive atmosphere does not form.
Lower Explosive Limit (LEL)	The LEL is the concentration of a flammable gas or vapour in air below which the propagation or spreading of a flame does not occur on contact with an ignition source (spark, open flame).

The relationships between the UEL, LEL and Explosive Range is shown in the diagram below:

Time Weighted Average (TWA)

The maximum average concentration to which an unprotected worker may be exposed over an eight-hour working day is called the Time Weighted Average or TWA value.

TWA values are calculated by taking the sum of exposure to a particular toxic gas in the current operating session in terms of parts-per-million-hours and dividing by an eight-hour period.

Short Term Exposure Limits (STEL)

Toxic substances may have short-term exposure limits that are higher than the eight hour **TWA**. The **STEL** is the maximum average concentration to which an unprotected worker may be exposed in any fifteen-minute interval during the day. During this time, neither the eight hour **TWA** or the ceiling concentration may be exceeded.

Any fifteen-minute periods in which the average **STEL** concentration exceeds the permissible eight-hour **TWA** must be separated from each other by at least one hour. A maximum of four of these periods are allowed per eight-hour shift.

Select and Calibrate Equipment

Once you have determined the need for atmospheric testing and monitoring, it is essential to select the correct equipment to measure the possible contaminants.

When selecting the equipment, you should refer to documents such as:

- Policies and procedures for organisational requirements.
- Surveys or geological data to determine the possible contaminants.
- Legislative or regulatory requirements.

You may also need to consult with relevant personnel/workers such as:

- Safety officers.
- Team members.
- Other designated personnel/workers.

Always select the equipment that is going to be most effective in the conditions.

Testing and Monitoring Equipment

Testing and monitoring equipment will vary depending upon the suspected substances and contaminants in the atmosphere.

The equipment that you select and use may include:

- Radiation detectors.
- Sampling tubes and pumps.
- Oxygen level meters.
- Carbon monoxide detectors.
- Combustible gas detectors.

Radiation Detectors

Radiation detectors are used to detect and measure radiation.

Detectors range from small devices attached to clothing, used by every member of the team, through to larger pieces of equipment that register and monitor the amount of environmental radiation present.

The type of radiation detector used will depend on your organisation, and the availability of trained personnel/workers capable of using the equipment and interpreting the results.

Sampling Tubes and Pumps

Sampling tubes and pumps are used to extract samples of the atmosphere for monitoring and testing.

Maintenance of sampling tubes and pumps should be conducted in line with the manufacturer's specifications to avoid cross contamination.

Oxygen Level Meters

In order to maintain a breathable atmosphere, oxygen should be between 19.5% and 23.5%.

A reading of 23.5% or higher means an increased risk of fire or explosion (referred to as oxygen enrichment).

A reading lower than 19.5% increases the risk of oxygen deprivation.

Carbon Monoxide Detectors

Carbon monoxide needs to be monitored closely as it is odourless, colourless and tasteless, but is poisonous.

Most multi-gas detectors detect carbon monoxide. However, your organisation may use a specific carbon monoxide detector.

Combustible Gas Detectors

Combustible gas detectors can be single gas detectors or multi-gas detectors.

The detectors to be used will be dependent upon resources within your organisation.

Many groups are moving to multi-gas detectors to limit the amount of equipment that needs to be carried and used.

Some of the detectors will be fixed or fitted to high-risk locations while other detectors will be portable. Portability allows the equipment to be taken to areas of need.

Each site should have a combination of fixed and portable detection equipment that allows them to best manage the testing requirements for their individual environmental conditions.

Calibrate Equipment

The equipment used will need to be calibrated according to the manufacturer's specifications.

Instructions for calibration must be specific to the equipment being used. You should consult the operator's manuals for instructions on calibrating the specific equipment that you are using.

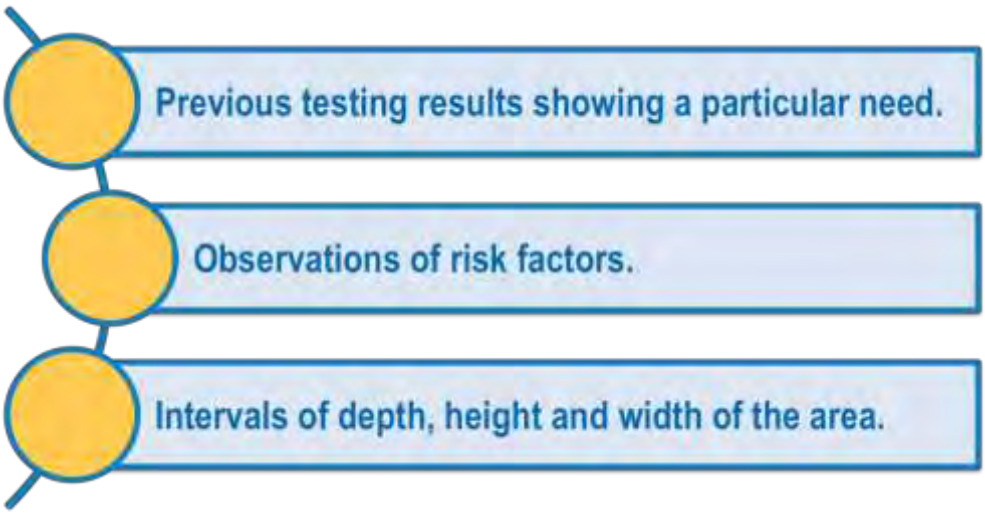
Determine a Testing Regime

Testing regimes are used to ensure the correct readings are taken in the correct order and at the correct intervals. Testing regimes and sampling patterns are determined by a combination of the:

- Testing equipment requirements.
- Legislative and regulatory requirements.
- Codes of practice, Australian standards and organisational policies and procedures.
- Types of contaminants found or expected.
- Activities and tasks being undertaken.
- Other site-specific factors.

Sampling patterns are used to determine the locations where testing should occur. In some cases, sampling patterns will be pre-determined by the location of fixed or fitted testing equipment.

In other situations it will be determined by a combination of factors such as:



Testing regimes and sampling patterns should be used to ensure tests are done in a timely manner and in the correct locations.

Always remember, be prepared to undertake additional testing outside of the sampling pattern and testing regime if you feel it is the safest option.

Identify Hazards

The identification of workplace hazards is essential to the safety of all personnel/workers on the worksite.

Identification of workplace hazards means looking for risks and hazards in any situation that could hurt you or another member of your team and evaluating the chances of the harm occurring. Each site and situation will have its own risks and hazards. By identifying all hazards within the workplace, you are able to develop effective controls to manage them.

Hazardous Materials and Toxic Substances

Many toxic substances are commonly encountered in industry. The presence of toxic substances may be due to materials being stored or used, the work being performed, or may be generated by natural processes. Exposure to toxic substances can produce disease, bodily injury, or death in unprotected workers.

The standard categories of substances that need to be monitored are: asphyxiates, irritants, corrosive substances and flammable gases.

Common substances you will be monitoring for will include:

Chemical Asphyxiates	Hydrocarbons, carbon dioxide, carbon monoxide, hydrogen cyanide, and hydrogen sulphide.
Irritants And Corrosives	Chlorine, ammonia and acid bases.
Flammable Gases	Acetylene, petroleum, methane, ethane, propane and butane.
Narcotics	Can be explosive as well as cause respiratory issues.

It is important to determine the amounts of any toxic materials and substances potentially present in the workplace.

Unprotected workers may not be exposed to levels of toxic contaminants that exceed Permissible Exposure Limit (PEL) concentrations. Ongoing monitoring is necessary to insure that exposure levels have not changed in a way that requires the use of different or more rigorous procedures or equipment.

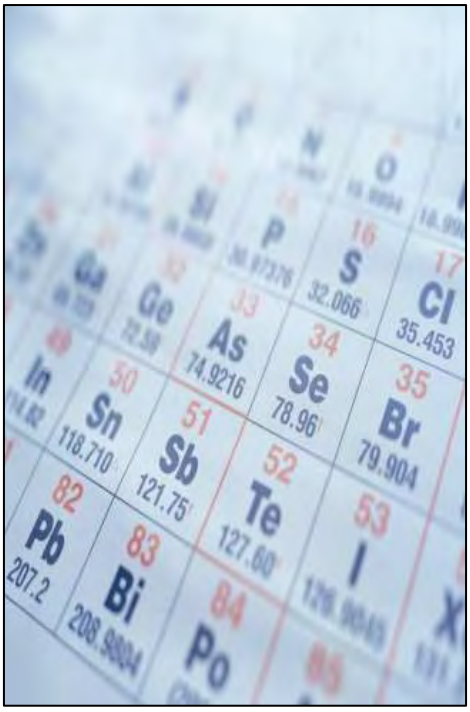
Acute and Chronic Effects of Toxic Substances

The toxic effect on humans from contaminants is dependent upon:

- The concentration of the contaminant.
- The mix or number of other contaminants.
- Unprotected exposure times to the contaminants.
- The base level of background environmental contamination.

Airborne toxic substances are typically classified on the basis of their ability to produce physiological effects on exposed workers. Toxic substances tend to produce symptoms in two time frames:

1. Higher levels of exposure tend to produce immediate effects (**acute**).
2. Lower levels of long-term exposure (**chronic**) may not produce physiological symptoms for years.



Hydrogen sulphide (H2S) is a good example of an acutely toxic substance that is immediately lethal at relatively low concentrations. Exposure to a 1,000-ppm (parts per million) concentration of H2S in air produces rapid paralysis of the respiratory system, cardiac arrest, and death within minutes.

Carbon monoxide (CO) is a good example of a chronically toxic gas. Carbon monoxide bonds to the haemoglobin molecules in red blood cells. Red blood cells contaminated with CO are unable to transport oxygen.

Although very high concentrations of carbon monoxide may be acutely toxic, and lead to immediate respiratory arrest or death, it is the long term physiological effects due to chronic exposure at lower levels that take the greatest toll on affected workers.

Some concentration levels of substances and their effects include:

Substance:	Effects:
Carbon Monoxide	Concentrations of approximately 50ppm have been known to cause ill effects. Symptoms of carbon monoxide poisoning include headache, nausea, vomiting, dizziness, fatigue and general muscle weakness, confusion, disorientation, visual disturbances and seizures.
Carbon Dioxide	Concentration levels of between 7% and 10% will cause dizziness, headaches, and sensory dysfunction leading to unconsciousness.
Hydrogen Cyanide	Hydrogen cyanide is lethal within approximately 10 minutes at concentrations of 300mg/m3 in air. In a gaseous state it is explosive at concentrations of greater than 5.6%.
Hydrogen Sulphide	Hydrogen sulphide is a highly toxic and flammable contaminate that can affect all systems of the body. The safe level is less than 10ppm over a day. Concentrations higher than 800ppm are lethal within 5 minutes for most people.
Chlorine	A concentration of 30ppm results in coughing, and lung damage starts at 60ppm. 1000ppm is considered fatal. Low-level concentration will affect the respiratory system and irritate the eyes.
Ammonia	Ammonia is a severe irritant to eyes and the respiratory tract. When mixed with other substances ammonia can become explosive.
Propane	Propane is heavier than air. It can be an asphyxiate due to this heaviness as it can 'push' out oxygen in confined spaces.
Butane	Butane can cause euphoria, drowsiness, narcosis, asphyxiation, and cardiac arrhythmia when in extremely high concentrations.

Each organisation will have a list of compounds and the concentrations at which they become toxic or hazardous. This list will generally be located with the measuring equipment, and must be present whenever readings are taken.

Causes of Harmful Atmospheres

A workplace atmosphere may be hazardous before work commences, or may become hazardous due to the work activities and tasks being conducted in the environment.

The potential for the atmosphere to change is why all atmospheres will need to be monitored closely.

Harmful atmospheres may arise from:

Situation	Example
The substance stored in the space or its by-products.	➢ The build-up of hydrogen sulphide in sewers and pits. ➢ The release of toxic substances, such as hydrogen sulphide, in a tank of decomposing organic material, especially when the material is disturbed.
The work performed in the confined space.	➢ The use of paints, adhesives, solvents or cleaning solutions. ➢ Welding or brazing with metals capable of producing toxic fumes. ➢ Exhaust fumes from engines used in the space. ➢ Painting or moulding glass-reinforced plastics.
The entry of natural contaminants such as groundwater and gases into the confined space from the surrounding land, soil or strata.	➢ Acid groundwater acting on limestone can lead to dangerous accumulations of carbon dioxide. ➢ Methane can be released from groundwater and from decay of organic matter.
The release of atmospheric contaminants.	➢ When sludge, slurry or other deposits are disturbed or when scale is removed.
The manufacturing process.	➢ Residues left in tanks, vessels etc., or remaining on internal surfaces, which can give off gas or vapour.
The entry and accumulation of gases and liquids from adjacent plant, installations, services or processes.	➢ The contamination of underground confined spaces by substances from plant many metres away. ➢ Carbon monoxide from the exhaust of LPG-powered forklifts operating in or close to the confined space.

Assess Risks

Once all hazards from possible atmosphere contaminants have been identified, you will need to assess the risks involved. Your risk assessment procedures may involve Risk Analysis and Risk Evaluation.

Risk Analysis

Risk analysis involves considering what are the causes and sources of the risks and comprises 3 factors:

Consequence	What would be the outcome of the event occurring? How severe would the outcome be?
Likelihood	What is the chance of the event/consequence occurring? Has the event happened before? Is it likely to happen again?
Risk Level	The combined result of likelihood and consequence.

Using a table similar to the one shown here you can analyse how high the risk level is.

LIKELIHOOD	CONSEQUENCE				
	Insignificant	**Minor** First Aid Required	**Moderate** Medical Attention and Time Off Work	**Major** Long Term Illness or Serious Injury	**Severe** Kill or Cause Permanent Disability or Illness
Almost Certain	**M**	**H**	**H**	**VH**	**VH**
Likely	**M**	**M**	**H**	**H**	**VH**
Possible	**L**	**M**	**H**	**H**	**VH**
Unlikely	**L**	**L**	**M**	**M**	**H**
Rare	**L**	**L**	**M**	**M**	**M**

Risk Evaluation

Risk evaluation is based upon the outcomes and results of the risk analysis.

Risk evaluation involves making decisions about which risks need to be treated and the order in which they should be treated. It should take into consideration the context of the risks in relation to:

- The organisation.
- The worksite.
- The relevant laws.
- Regulations.
- Other policies, procedures and requirements.

Using a table similar to the one shown you can evaluate how soon you should act to remove or control the hazard to achieve an acceptable level of risk.

RISK LEVEL	ACTION
VERY HIGH	Act immediately: The proposed task or process activity must not proceed. Steps must be taken to lower the risk level to as low as reasonably practicable using the hierarchy of risk controls.
HIGH	Act today: The proposed activity can only proceed, provided that: ▪ The risk level has been reduced to as low as reasonably practicable using the hierarchy of risk controls. ▪ The risk controls must include those identified in legislation, Australian Standards, Codes of Practice etc. ▪ The risk assessment has been reviewed and approved by the Supervisor. ▪ A Safe Working Procedure or Safe Work Method has been prepared. ▪ The supervisor must review and document the effectiveness of the implemented risk controls.
MEDIUM	Act this week: The proposed task or process can proceed, provided that: ▪ The risk level has been reduced to as low as reasonably practicable using the hierarchy of risk controls. ▪ The risk assessment has been reviewed and approved by the Supervisor. ▪ A Safe Working Procedure or Safe Work Method has been prepared.
LOW	Act this month: Managed by local documented routine procedures, which must include application of the hierarchy of controls.

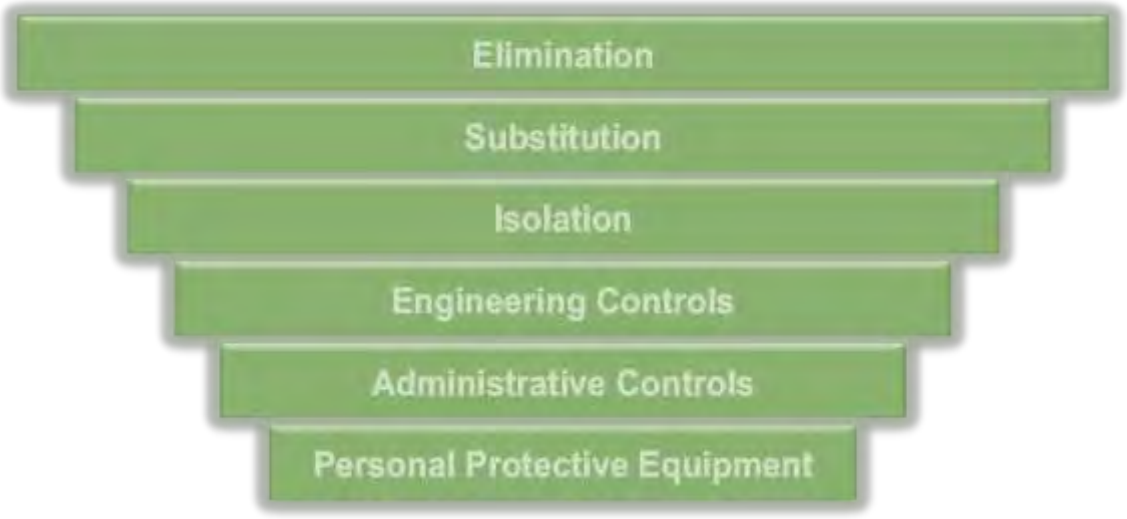
Any task with a Very High risk level is absolutely unacceptable to carry out. Steps must be taken to reduce the risk level.

Apply Hazard Control Measures

Once hazards and risks have been identified, analysed and evaluated, hazard control measures (called risk treatment options) need to be considered and applied.

Consider Hazard/Risk Control Strategy Options

The Hierarchy of Hazard Control is the name given to a range of control methods used to eliminate or control hazards and risks in the workplace. The Hierarchy has 6 levels:



It is important to understand what each level in the Hierarchy stands for and how they can be implemented into your work.

Level	Description
1. Elimination	Completely remove the hazard. This is the best kind of hazard control.
2. Substitution	Swap a dangerous work method or situation for one that is less dangerous.
3. Isolation	Isolate or restrict access to the hazard.
4. Engineering Controls	Use equipment to lower the risk level.
5. Administrative Controls	Site rules and policies attempt to control a hazard. Includes Safe Work Practices.
6. Personal Protective Equipment	The least effective control. Use PPE while you carry out your work. This should be selected at the planning stage of your work, and checked before starting the job.

It is important to consider all of the options available when deciding on the best course of action. Not all options are feasible or possible under some circumstances. You may need to use a number of control measures in conjunction to reduce the risk level to an acceptable level. Risk treatment measures must be specific to the contaminants you expect to find, and will include the use of Personal Protective Equipment (PPE).

The risk treatment plan should clearly identify the order in which to implement the individual risk treatments.

Implement the Control Strategy

Consult with other workers and management to ensure the implementation is done correctly and does not have a negative bearing on other trades, procedures or workers.

Once the risk control measure is in place you will need to review the level of risk to determine if more needs to be done to lower the risk level.

The acceptable level of risk is determined by an organisation's policy, goals and objectives towards safety.

Talk to your supervisor or health and safety representative if you are not sure about whether or not the risk has been reduced enough to carry out the work.

If you determine the risk to be at an unacceptable level, the work must not be carried out until an authorised person can review the situation.

Test Atmospheres and Maintain Equipment

Use Equipment to Test Gas

Prior to conducting gas testing procedures, you will need to ensure that you have adequate hazard controls in place, including appropriate Personal Protective Equipment (PPE).

Personal Protective Equipment

The Personal Protective Equipment (PPE) and clothing that you can use will depend on the tasks to be conducted, their location, and the hazards and risks involved.

Common items of PPE that you may need to wear and use include:

- Eye protection, e.g. goggles or eye shields.
- Ear protection, e.g. earmuffs or earplugs.
- Gloves.
- Protective clothing, e.g. long sleeve shirts and trousers, coveralls, reflective clothing.
- Helmets, which meet the required Australian Standards.
- Safety footwear, e.g. steel capped boots.
- Chemical protective equipment – HAZMAT clothing.
- Respiratory protection, e.g. breathing masks, breathing apparatus (as necessary).
- Other relevant PPE.

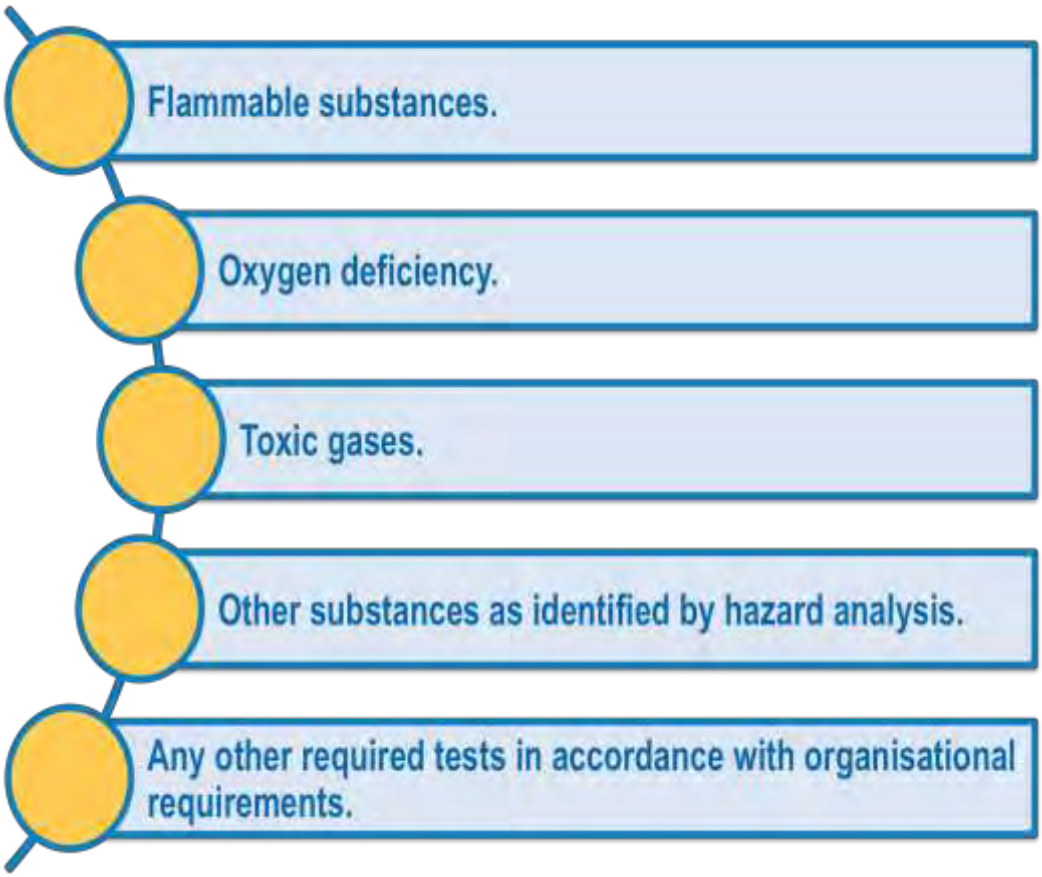
It is essential that you select the appropriate equipment and clothing for the situation to ensure your safety and the safety of all personnel/workers.

Initial Testing

Initial testing needs to be done from outside of a confined space by inserting a sample probe at appropriately selected access holes, nozzles and openings.

These tests will need to be completed in accordance with the manufacturer's specifications and directions for the equipment used.

Using a calibrated direct-reading instrument with remote sampling capacity, you may need to test for:



Always ensure you are aware of what the requirements and procedures are for using the testing equipment available to you. If you have not used the equipment before or have not conducted tests of the required nature before, have someone check your readings to ensure the accuracy of the reading.

Conduct Sampling

Once you have determined which piece of equipment you will need to use to test and monitor the atmospheric conditions, and have calibrated the equipment as required, you will need to take the appropriate atmospheric readings.

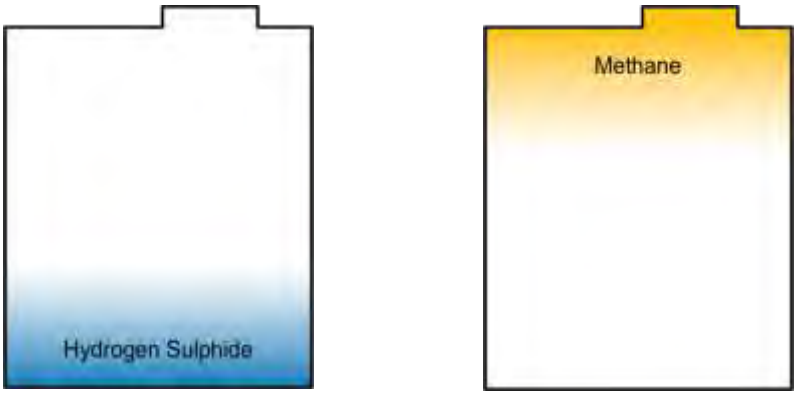
The appropriate sample will be dependent upon the type of equipment used, the contaminants being tested for, and the operational requirements of your organisation.

You will find this information in the operator's manuals for the equipment you are using and the procedural manuals for your organisation.

Best practice is to have a qualified person test a confined space a minimum of three times at all levels immediately prior to entry, before an entry permit is issued.

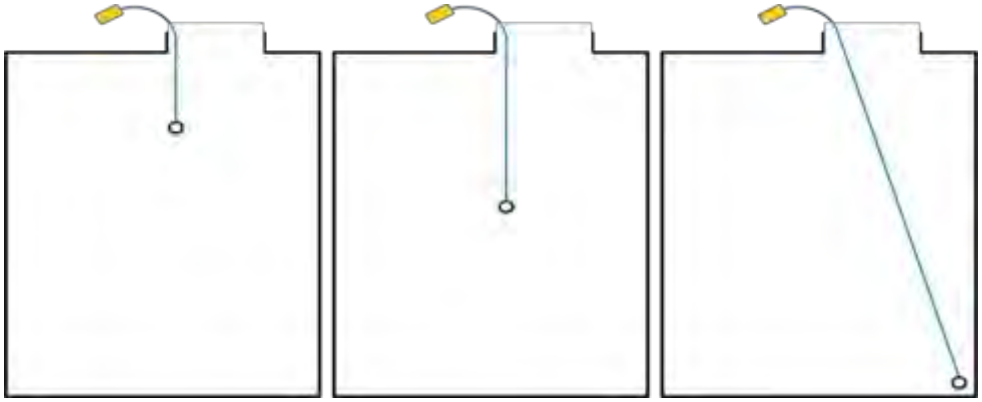
As it is possible for contaminants to settle at different levels, the top, middle and bottom of the space needs to be tested.

For example, some gases (such as hydrogen sulphide) are heavier than air and in unventilated areas will settle to the bottom of the space, while other gases (such as methane) are lighter than air and will collect at the top of the space.



Tests need to be made at a sufficient number of points to accurately reflect areas of the space that are likely to be accessed.

If it is necessary to enter the space to test remote regions away from entrances or access holes, then a self-contained breathing apparatus needs to be worn and the entry needs to be undertaken in accordance with the regulations using a confined space entry permit.



Liquids in a Confined Space

Any liquids should be pumped out of a confined space and liquid flow diverted from the space before testing for toxic gases is carried out.

If the liquid cannot be removed then it should be stirred as vigorously as possible while testing takes place. The stirring should be mechanical using a stirrer or pump or by blowing compressed air through the bottom of the space.

Stirring the liquid manually with a paddle will not give sufficient agitation to release the trapped gases.

Interpret and Report Readings

Once readings of contaminants are taken, the results must be interpreted and analysed, as well as recorded.

Readings may also be compared with appropriate specifications and exposure limits.

Each item of testing equipment will have different methods of reading results. You must be aware of how these results are to be read.

In order to read and interpret the results you will need to have adequate literacy and numeracy skills.

These skills will help you to read the testing equipment, determine whether the results are safe or not safe, and work out the actions that should be taken.

Analysis of readings should not be taken in isolation. You may be required to compare the combined readings and effects to determine how substances may interact with each other.

Ensure that when analysing and comparing the readings of contaminants that all data is collected, collated and understood. Computer programs may be used to collate and compare the data.

Ensure that you follow your organisation's methods and procedures when analysing and comparing all readings.

In order to be able to interpret and analyse the readings and make comparisons you must be able to understand the contaminants themselves, how they are expressed as a unit of measurement, the exposure standards that exist, and the toxic effects on humans.

Contaminant Units of Measurement

How a unit of contaminant is expressed depends upon the type of contaminant.

For example, gases such as oxygen, carbon monoxide, and carbon dioxide are expressed as a percentage of atmospheres, while irritants may be expressed as Parts Per Million (PPM) or milligrams per cubic metre (mg/m^3).

Each contaminant that may be present could have different ways of expressing its concentration depending upon the equipment used to take the measurements, the composition of the samples and the organisational requirements.

Gas testing equipment may use a number of units of measurement to report gas levels.

These could include:

Unit Abbreviation	Meaning
mg/cubic m	Milligrams per cubic metre
PPM	Parts Per Million
%	Percent (rating of how many parts per one hundred)
UEL %	Upper Explosive Limit rating
LEL %	Lower Explosive Limit rating
v/v	Volume in volume (usually referring to level of oxygen)

Exposure Standards

Exposure standards are guidelines regarding the concentrations of individual chemical substances that should not impair health to workers. Exposure standards can be measured or expressed in the following ways:

Exposure Standards	Description
Time Weighted Average	Time weighted averages measure the exposure to contaminants over a set period of time, usually 8 hours. This ensures that you can be safely exposed to a chemical over a certain period of time, as long as the exposure does not exceed the specified amount.
Short Term Exposure Limit	The short-term exposure limit is the amount of exposure allowed in a set short period of time. This is normally calculated in time bundles of between 10 and 20 minutes, and expressed as parts per million.
Peak Limitation Values	Peak limitation values relate to the maximum concentration of a contaminant that must not be exceeded. Anything that is past the maximum concentration point should be considered to be toxic.

Report Results

Upon completion of the analysis and comparison of readings, it is necessary to report the results to your commanding officer, management team, team leader or other designated personnel/workers.

Results will normally be communicated verbally, either in a face-to-face situation or using an appropriate communication system.

A written report will then also be passed on to appropriate personnel/workers.

When atmospheric readings, testing and monitoring is an ongoing activity, and the atmospheric readings reach a hazardous or dangerous level, the technician who is operating the equipment will need to communicate these results in accordance with the operational requirements for the organisation.

Along with the communication of atmospheric reading results, the technician may also provide recommendations for actions to be taken. The recommended actions will be based on the substances that are being dealt with and the readings recorded.

Recommending Actions

An atmosphere becomes hazardous when it is unable to adequately support life, could induce an injury or illness, or poses a threat of further dangers such as explosions.

If you realise the atmosphere has become dangerous, you will need to immediately make recommendations to the people operating in the atmosphere.

These recommendations should always ensure the safety of the personnel/workers first.

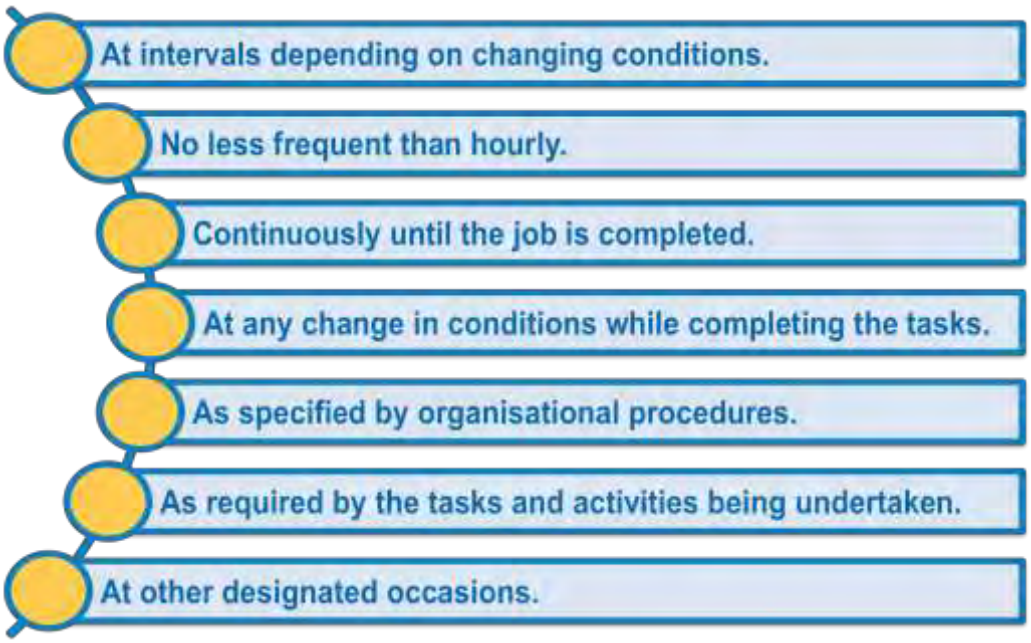
Conduct Ongoing Monitoring

If there is any reason to suspect that the atmosphere or conditions faced during operations may alter, the atmosphere should be monitored on an ongoing basis.

Re-testing and continuous monitoring of the atmosphere may be necessary due to the work being done or the disturbance of hazardous material, such as sludge.

A confined space must be continually monitored where the concentration of flammable gas or vapour in the space is equal to or greater than 5% but less than 10% of its lower explosive limit.

There should be continued atmospheric testing while any workers are inside a confined space or area:



Each worker may also wear a continuous monitoring device. The device should be capable of sounding an alarm if dangerous gas levels or oxygen deficiency develop.

If there are strong indications that the atmosphere may change suddenly, all people entering a confined space must wear self-contained breathing apparatus.

Take Action if Readings Pose an Unacceptable Risk

If any readings pose an unacceptable risk to workers or those in the area, you will need to take appropriate action in accordance with workplace requirements and environmental conditions.

Common actions could include:

- Reporting the readings to relevant personnel/workers.
- Purging the atmosphere by:
  - Blowing air through the space.
  - Extracting toxic gases with a suitable exhaust system.
  - A combination of blowing and exhausting.
- Evacuation of personnel/workers.
- Stopping actions and activities and allowing the atmosphere to clear by itself.
- Adapting PPE requirements.
- Other site-specific requirements

Care should be taken to prevent people outside a confined space from being exposed to gas while the atmosphere inside the confined space is being purged. Care must also be taken when purging flammable gases.

Do not use pure oxygen or gases with a higher oxygen level of 21% for purging purposes. Ventilation such as exhaust fans can be used to remove hazardous gasses and contaminants.

Any purging of a confined space needs to be followed up with proper ventilation procedures.

Alternatively, people can enter the space if they wear an approved air-supplied respirator (self-contained breathing apparatus), so long as there are no flammable gases present in the confined space.

Using Purging Agents

Purging agents are those substances that are used to remove (purge) contaminants from an area. Each contaminant will have a purging agent that works best.

Purging agents should never oxygen enrich the atmosphere, therefore never use a gas or agent that has oxygen content higher than 21%.

Ventilation is a successful purging agent if it can be used safely. Exhaust fans have been successfully used in some situations where gases and other substances have been able to be 'pushed' out of confined spaces.

The purging agent used will depend upon the contaminants you are dealing with and the designated processes and protocols for your organisation.

Actions taken on unacceptable test results and readings must follow workplace and organisational procedures, with care being taken to not contaminate the environment.

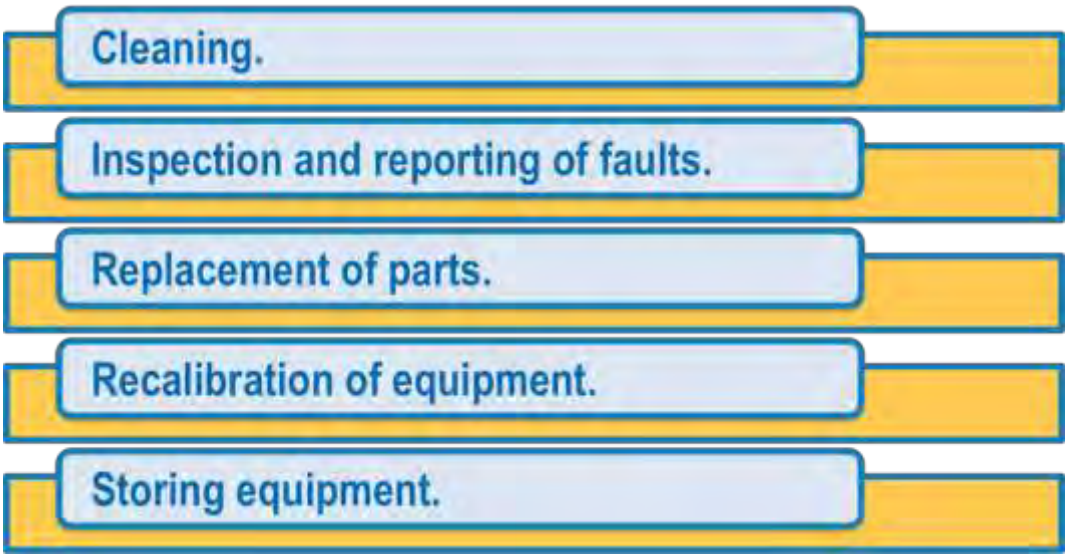
At all times, keep your management team informed of what actions you are taking and why they are necessary.

Maintain Gas Testing Equipment

After use, each item of gas testing equipment will need to be maintained in accordance with the organisational procedures and manufacturer's specifications. It is important that the equipment is maintained in a clean and operationally ready state to ensure accurate readings when the equipment is next used.

Maintenance Procedures

Common maintenance procedures for gas testing equipment will include:



Cleaning

Information about cleaning each component of the testing and monitoring equipment will be found in the procedural and operator's manuals.

For example, IR gas detectors may need to have the lens cleaned if it becomes dirty.

Ensure that the steps are followed accurately, and that you take any necessary safety precautions.

Inspection and Fault Finding

It is necessary for all testing and monitoring equipment to be inspected and tested to identify any faults or damage.

Inspecting the equipment may include checking over the equipment structurally for damage, and conducting appropriate testing procedures.

This may require the equipment to be serviced in-house or outsourced to a testing laboratory, depending on the equipment and the organisational procedures and policies.

Any testing procedures taking place will need to be conducted according to the manufacturer's specifications and recommendations. These specifications will be found in the operator's manual for each individual piece of equipment.

If any items of testing equipment are faulty or damaged, you will need to report these faults in accordance with your workplace requirements. At all times, ensure you isolate the faulty equipment to ensure it is not used again until the fault has been rectified and the item returned to use.

Replacement or Calibration

Some gas detectors require routine replacement of cartridges to keep in proper working order.

Batteries may need to be recharged or replaced.

Refer to the manufacturer's operating manual for the steps to be followed when replacing parts or recalibrating testing and monitoring equipment.

Storing Equipment

Testing and monitoring equipment must be stored in accordance with the manufacturer's specifications and workplace requirements to ensure it is fit for use when next needed.

By returning the equipment to the required location you are ensuring the item is able to found when it is next needed.

All equipment must be returned to the appropriate and designated storage location in the condition required by the manufacturer. Make sure that you are familiar with the storage location and condition requirements prior to beginning maintenance on the equipment.

Maintain Records

Every organisation will have procedures to ensure every test conducted and result received is linked to each other, and then linked to a testing and monitoring event.

Depending on the testing and monitoring results, you may be required to notify legislative bodies of the test results.

If this is a requirement, it will be noted in the procedures for those tests.

How this is done will vary between organisations, but should be done at the completion of each incident.

Each organisation will have defined procedures which will outline what information needs to be recorded, where it needs to be recorded and when it needs to be recorded.

This information will be located in your organisational operation's manual.

In order to complete records, you will need to have adequate writing skills, including the ability to write clearly and legibly.

It is essential that you understand the reporting, documentation and maintenance requirements for your organisation.