



# MSMWHS217

## Gas Test Atmospheres



# LEARNER GUIDE

# Table of Contents

<b>1.1 Introduction .....</b>	<b>3</b>
1.1.1 Gas Testing Safety Information.....	3
1.1.1.1 Organisational Procedures and Policies .....	3
<b>1.2 Determine Atmosphere to be Tested.....</b>	<b>4</b>
1.2.1 Testing and Work Permits.....	4
1.2.2 Hazardous Atmospheres.....	5
1.2.2.1 Explosive Range .....	5
Upper Explosive Limit (UEL).....	5
Lower Explosive Limit (LEL) .....	5
<b>1.3 Select and Calibrate Equipment .....</b>	<b>6</b>
1.3.1 Testing and Monitoring Equipment .....	6
1.3.1.1 Radiation Detectors .....	7
1.3.1.2 Sampling Tubes and Pumps .....	7
1.3.1.3 Oxygen Level Meters .....	7
1.3.1.4 Carbon Monoxide Detectors.....	7
1.3.1.5 Combustible Gas Detectors.....	7
1.3.2 Calibrate Equipment.....	8
1.3.2.1 Function Tests .....	8
<b>1.4 Determine a Testing Regime .....</b>	<b>8</b>
<b>1.5 Identify Hazards.....</b>	<b>9</b>
1.5.1 Hazardous Materials and Toxic Substances.....	9
1.5.2 Causes of Harmful Atmospheres.....	10
<b>1.6 Apply Hazard Control Measures .....</b>	<b>11</b>
1.6.1 Personal Protective Equipment.....	12
<b>2.1 Testing Atmospheres.....</b>	<b>13</b>
2.1.1 Conduct Sampling.....	13
2.1.1.1 Liquids in a Confined Space.....	14
<b>2.2 Interpret and Report Readings .....</b>	<b>14</b>
2.2.1 Contaminant Units of Measurement.....	15
2.2.2 Exposure Standards .....	15
2.2.2.1 Acute and Chronic Effects of Toxic Substances.....	15
2.2.3 Report Results.....	16
2.2.3.1 Recommending Actions.....	17
<b>2.3 Conduct Ongoing Monitoring .....</b>	<b>17</b>
<b>2.4 Take Action if Readings Pose an Unacceptable Risk .....</b>	<b>18</b>
2.4.1 Using Purging Agents.....	18
<b>2.5 Maintain Gas Testing Equipment.....</b>	<b>19</b>
2.5.1 Cleaning .....	19
2.5.2 Inspection and Fault Finding .....	19
2.5.3 Replacement or Recalibration.....	20
2.5.4 Storing Equipment .....	20
<b>2.6 Maintain Records.....</b>	<b>20</b>

# 1.1 Introduction

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

You will learn about:

- ◆ Preparing for gas testing.
- ◆ Testing gas.
- ◆ Maintaining equipment.



## 1.1.1 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.

### 1.1.1.1 Organisational Procedures and Policies

Organisational procedures and policies that support safety could include:

- ◆ Work permit systems.
- ◆ Safety, hazards and hazard control.
- ◆ Incident, fire and accident.
- ◆ PPE.
- ◆ Organisation standard operating procedures (SOPs).



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

## 1.2 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 may develop in areas including:

- ◆ Confined spaces.
- ◆ Enclosed and partially enclosed spaces.
- ◆ Hot work areas.
- ◆ Storage tanks, silos, pits, pipes, shafts, ducts, transport vehicles and ships.
- ◆ Open areas.

If there is any doubt about the safe completion of tasks and activities due to atmospheric conditions, it is necessary to test for:

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



Testing the atmosphere 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.

### 1.2.1 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.

If you are responsible for the issuing of work permits 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.



A work permit will list the required atmospheric testing which may include testing prior to starting work, testing to monitor the atmosphere during work and/or testing at the completion of work activities.

## 1.2.2 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. <ul style="list-style-type: none"><li>◆ Primary irritants have limited effects on the entire system or body.</li><li>◆ A secondary irritant atmosphere could have systemic effects on the body.</li></ul>
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).

### 1.2.2.1 Explosive Range

The Explosive Range is the range of concentrations where a substance may be explosive.



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:



# 1.3 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 such as:

- ◆ Safety officers.
- ◆ Team members.
- ◆ Other designated personnel.

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



## 1.3.1 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.

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

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.

### **1.3.1.1 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 capable of using the equipment and interpreting the results.



### **1.3.1.2 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.



### **1.3.1.3 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.

### **1.3.1.4 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.

### **1.3.1.5 Combustible Gas Detectors**

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

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



## 1.3.2 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.

The frequency of calibration depends on the reasons for conducting the testing and how often the equipment is used. If the readings are required for court purposes you may need to calibrate the equipment both before and after use. Alternatively, if you only use the equipment occasionally you might only need to calibrate it before each use.

Your organisation's procedures should detail the required frequency of calibration.



### 1.3.2.1 Function Tests

Function (or bump) tests are a simple check where a test gas is used to trigger the alarm mode and demonstrate overall operation of the equipment. It is a good idea to conduct these tests every day the equipment is used.

Information on how to complete these should be included in your organisation's procedures or the manufacturer's specifications.



## 1.4 Determine a Testing Regime

Testing regimes are used to ensure the correct readings are taken in the correct order and at the correct intervals. Workplace policies and procedures or task instructions should provide details of the required testing regime and sampling pattern.



Testing regimes and sampling patterns are determined by a combination of the following:

- ◆ 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:

-  Previous testing results showing a particular need.
-  Observation of risk factors.
-  Intervals of depth, height and width of the area.

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.

## 1.5 Identify Hazards

The identification of workplace hazards is essential to the safety of all personnel 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.



### 1.5.1 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.

Common gases or 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 must 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.

## 1.5.2 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.	<ul style="list-style-type: none"><li>◆ The build-up of hydrogen sulphide in sewers and pits.</li><li>◆ The release of toxic substances, such as hydrogen sulphide, in a tank of decomposing organic material, especially when the material is disturbed.</li></ul>
The work performed in the space.	<ul style="list-style-type: none"><li>◆ The use of paints, adhesives, solvents or cleaning solutions.</li><li>◆ Welding or brazing with metals capable of producing toxic fumes.</li><li>◆ Exhaust fumes from engines used in the space.</li><li>◆ Painting or moulding glass-reinforced plastics.</li></ul>
The entry of natural contaminants such as groundwater and gases into the space from the surrounding land, soil or strata.	<ul style="list-style-type: none"><li>◆ Acid groundwater acting on limestone can lead to dangerous accumulations of carbon dioxide.</li><li>◆ Methane can be released from groundwater and from decay of organic matter.</li></ul>
The release of atmospheric contaminants.	<ul style="list-style-type: none"><li>◆ When sludge, slurry or other deposits are disturbed or when scale is removed.</li></ul>
The manufacturing process.	<ul style="list-style-type: none"><li>◆ Residues left in tanks, vessels etc., or remaining on internal surfaces, which can give off gas or vapour.</li></ul>
The entry and accumulation of gases and liquids from adjacent plant, installations, services or processes.	<ul style="list-style-type: none"><li>◆ The contamination of underground confined spaces by substances from plant many metres away.</li><li>◆ Carbon monoxide from the exhaust of LPG-powered forklifts operating in or close to the confined space.</li></ul>

# 1.6 Apply Hazard Control Measures

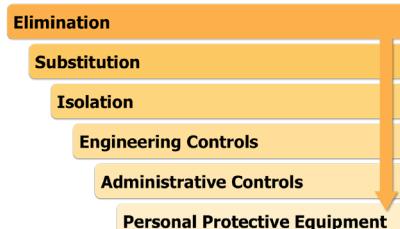
Once hazards and risks have been identified, analysed and evaluated, hazard control measures need to be considered and applied.

The best way to control hazards is to use the Hierarchy of Hazard Control. 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.

You start at the top of the list and see if you can take away (eliminate) the hazard or danger.

If you can't take it away you move down the list to see if you can swap it for something safer (substitution).

Keep working through the list until you find something that controls that hazard or danger.



This table shows you the 6 different types of controls in order from best to worst:

Hierarchy Level	Action
<b>1. Elimination</b>	Completely remove the hazard. This is the best kind of hazard control.
<b>2. Substitution</b>	Swap a dangerous work method or situation for one that is less dangerous.
<b>3. Isolation</b>	Isolate or restrict access to the hazard.
<b>4. Engineering Controls</b>	Use equipment to lower the risk level.
<b>5. Administrative Controls</b>	Site rules and policies attempt to control a hazard.
<b>6. Personal Protective Equipment</b>	The least effective control. Use PPE while you carry out your work.



Hazard control measures need to be put in place before you start your work, or as soon as you see a hazard while you are doing your work. Hazard controls can sometimes be listed in your work instructions or you can ask your boss or supervisor for help.

Once a hazard control is in place you will need to check to make sure it is working well to control the hazard or danger.

Talk to your supervisor or safety officer if you are not sure if it is safe enough to carry out your work. If you think the hazard is still too dangerous you should not try to do the work.

## 1.6.1 Personal Protective Equipment

Personal Protective Equipment (PPE) is clothing and equipment designed to lower the chance of you being hurt on the job. It is required to enter most work sites. The required PPE should be listed in your organisational procedures.

PPE can include:

- ◆ Head protection – hard hats and helmets.
- ◆ Foot protection – non-slip work boots.
- ◆ Hand protection – gloves.
- ◆ Eye protection – goggles, visors or glasses.
- ◆ Ear protection – plugs or muffs.
- ◆ Breathing protection – masks or respirators.
- ◆ Chemical protective equipment – HAZMAT clothing.
- ◆ Hi-visibility clothing – clothing that makes you stand out and lets other people know where you are.
- ◆ Weather protection – clothing that protects you from the sun or from the cold.



Make sure any PPE you are wearing is in good condition, fits well and is right for the job.

If you find any PPE that is not in good condition, tag it and remove it from service. Tell your supervisor about the problem and they will organise to repair or replace the PPE.

## 2.1 Testing Atmospheres

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



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

Follow the required testing regime or sampling pattern.

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.

### 2.1.1 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 depend upon:

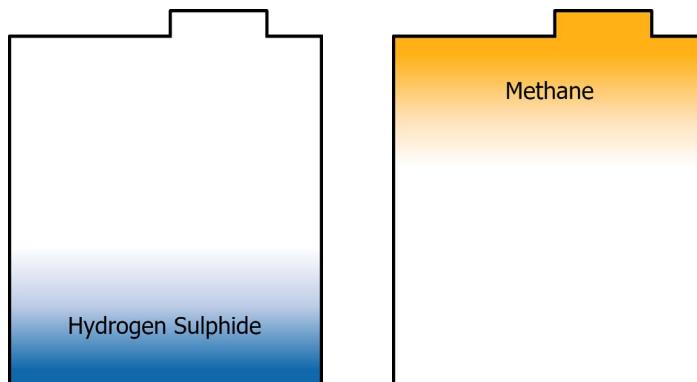
- ◆ The type of equipment used.
- ◆ The contaminants being tested for.
- ◆ The operational requirements of your organisation.

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

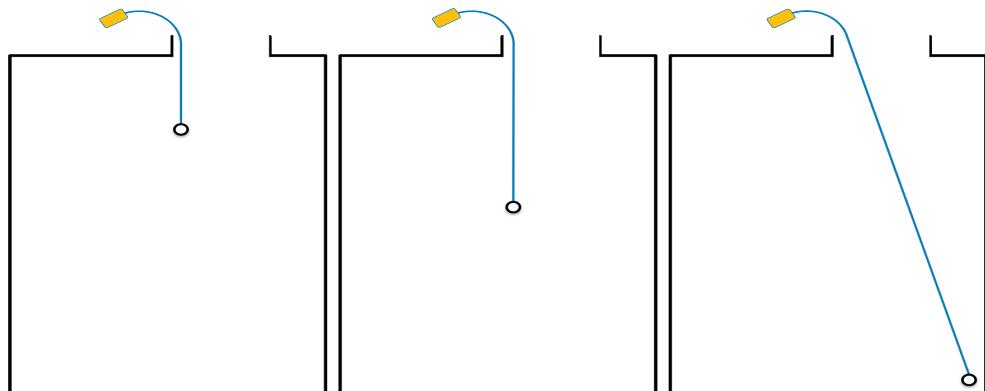


As it is possible for contaminants to settle at different levels, the top, middle and bottom of the space needs to be tested.

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 self-contained breathing apparatus needs to be worn and the entry needs to be undertaken in accordance with the regulations using an appropriate permit.

### 2.1.1.1 Liquids in a Confined Space

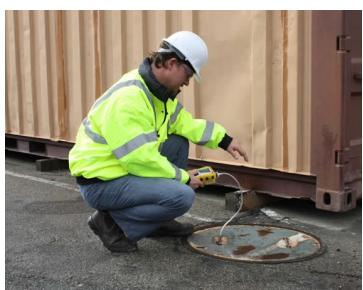


Any liquids should be pumped out of a confined space and liquid flow diverted from the space before testing for toxic gases is carried out.

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.

## 2.2 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.

You will need 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.



## 2.2.1 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 atmosphere or Volume in Volume (v/v), while irritants may be expressed as Parts per Million (PPM) or milligrams per cubic metre (mg/m<sup>3</sup>).

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

## 2.2.2 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 Standard	Description
<b>Time Weighted Average (TWA)</b>	TWA 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.
<b>Short Term Exposure Limit (STEL)</b>	The STEL may be higher than the eight hour TWA. It 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 nor 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.
<b>Peak Limitation Values</b>	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.

### 2.2.2.1 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.

Some concentration levels of substances and their effects include:

Substance	Effects
<b>Carbon Monoxide</b>	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.
<b>Carbon Dioxide</b>	Concentration levels of between 7% and 10% will cause dizziness, headaches, and sensory dysfunction leading to unconsciousness.
<b>Hydrogen Cyanide</b>	Hydrogen cyanide is lethal within approximately 10 minutes at concentrations of 300mg/m <sup>3</sup> in air. In a gaseous state it is explosive at concentrations of greater than 5.6%.
<b>Hydrogen Sulphide</b>	Hydrogen sulphide is a highly toxic and flammable contaminant 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.
<b>Chlorine</b>	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.
<b>Ammonia</b>	Ammonia is a severe irritant to eyes and the respiratory tract. When mixed with other substances ammonia can become explosive.
<b>Propane</b>	Propane is heavier than air. It can be an asphyxiate due to its heaviness as it can 'push' out oxygen in confined spaces.
<b>Butane</b>	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.

## 2.2.3 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.

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.

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.

### 2.2.3.1 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 workers first. Follow your procedures and training as well as drawing on your previous experience.



## 2.3 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.

If monitoring is required it should be conducted:

- At intervals, depending on changing conditions.
- No less frequently than hourly.
- Continuously, until the job is completed.
- At any change in conditions while completing the tasks.
- As specified by organisational procedures.
- As required by the tasks and activities being undertaken.
- At other designated occasions.

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.

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.

## 2.4 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.
- ◆ 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.
- ◆ 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 an area from being exposed to gas while the atmosphere inside the area 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 area if they wear an approved air-supplied respirator (self-contained breathing apparatus), so long as there are no flammable gases present.

### 2.4.1 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.

## 2.5 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.

Common maintenance procedures for gas testing equipment will include:

-  Cleaning.
-  Inspection and reporting of faults.
-  Replacement of parts.
-  Recalibration of equipment.
-  Storage of equipment.

### 2.5.1 Cleaning

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



For example, infrared 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.

### 2.5.2 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.

## 2.5.3 Replacement or Recalibration

Some gas detectors require routine replacement of cartridges to keep them 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.



## 2.5.4 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 be 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.

## 2.6 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.

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

