



Preventing harm from hydrogen sulphide

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1.0

Introduction

What this guide is about

This quick guide is for any persons conducting a business or undertaking (PCBUs) whose work may expose workers and other people to hydrogen sulphide.

PCBUs must ensure, so far as is reasonably practicable, the health and safety of workers and other people are not put at risk by their work.

In this quick guide, 'you' means the PCBU.

2.0

What is hydrogen sulphide and where can it be found?

What is hydrogen sulphide?

Hydrogen sulphide (H₂S) is a highly toxic, colourless (transparent) gas which is heavier than air. The gas is corrosive and flammable.

Hydrogen sulphide can paralyse a person's breathing system and kill in minutes. Even in small amounts, it can be dangerous to health.

Where can hydrogen sulphide be found?

Hydrogen sulphide is naturally occurring in geothermal areas and is emitted from volcanoes, undersea vents, swamps and stagnant bodies of water.

It is often a by-product of some industrial processes (see Table 1 below).

It is important for PCBUs and workers to understand the risks or likelihood of exposure to hydrogen sulphide.

PROCESS	INDUSTRY
Manure and offal pits	Agriculture
Removal of hair from hides	Fellmongery/leather tanning
Extraction bores, thermal springs and pools Drilling and civil works	Geothermal
Treatment of toxic waste	Hazardous waste
Drilling Production and refining	Oil and gas
Manufacturing processes	Pulp and paper
Sewers, tanks and sewage treatment plants	Water and wastewater

TABLE 1: Industries and processes where hydrogen sulphide is often a by-product

Hydrogen sulphide may also be found:

- in or near confined spaces such as tanks, pits, ballast tanks (stagnant water), cellars and sumps
- in or near semi-enclosed, poorly ventilated areas. For example, thermal bathing pools can release gases which may become highly concentrated if the area is not well ventilated
- wherever there is rotting organic material, particularly where there is not much oxygen. For example, worksites where contractors were engaged to clear rotting vegetation underwater
- in environments such as construction and plumbing sites. For example, during the installation and maintenance of stormwater drains, electric or telephone cables and trenchwork.

For more information, see WorkSafe's webpage [Working safely in a confined space](#)

3.0

What are the health effects from exposure to hydrogen sulphide?

When inhaled, hydrogen sulphide is absorbed through the lungs and into the blood. Exposure to low levels of the gas may cause irritation to the eyes, nose and throat. Exposure to high levels may cause shortness of breath, lung damage, or cardiac arrest.

Inhaling very high levels of hydrogen sulphide may cause immediate collapse and death.¹

The level of harm to workers caused by exposure to hydrogen sulphide depends on:

- duration: the length of time they are exposed to the gas
- frequency: how often they are exposed
- intensity: how much (concentration) gas they are exposed to
- individual susceptibility: including the worker's general wellbeing, health and fitness.²



YOU CANNOT RELY ON YOUR SENSE OF SMELL TO DETECT HYDROGEN SULPHIDE

Small amounts of hydrogen sulphide (low concentrations) smell like rotten eggs, or the gas may smell sickly sweet.

However, hydrogen sulphide rapidly deadens the sense of smell. This means when there is a large amount of the gas (high concentrations), you will not be able to smell it (refer to Table 2 below). This makes hydrogen sulphide very dangerous. You may think the gas is no longer there when in actual fact, its levels may have increased.

Having a cold or other flu-like symptoms will also affect a person's ability to smell the gas.

¹ Levels above 500ppm may cause immediate collapse, and concentrations at 100ppm are dangerous to life and health.

² There may be other factors present such as humidity, and air movement.

The following table describes the effects that may occur at specific hydrogen sulphide levels.³ There can also be less apparent, delayed effects from exposure to low levels of hydrogen sulphide.

CONCENTRATION IN PARTS PER MILLION (ppm) ⁴	OBSERVATIONS AND HEALTH EFFECTS
Less than 1	Most people smell something similar to rotten eggs.
3 to 5	Odour is strong.
20 to 150	Nose and throat feel dry and irritated. Eyes sting, itch or water, and 'gas eye' ⁵ symptoms may occur. Prolonged exposure may cause coughing, hoarseness, shortness of breath, and runny nose. Hydrogen sulphide levels of 100ppm and higher are immediately dangerous to life and health.
150 to 200	Sense of smell is blocked (olfactory fatigue).
200 to 250	Major irritation of the nose, throat and lungs occurs, along with headaches, nausea, vomiting, and dizziness. Prolonged exposure can cause fluid build-up in the lungs (pulmonary oedema), which can be fatal.
300 to 500	Symptoms are the same as above but more severe. Death can occur within 1-4 hours of exposure.
Above 500	Immediate loss of consciousness. Death is rapid, sometimes immediate.

TABLE 2:
Potential health effects at specific hydrogen sulphide levels



Hydrogen sulphide levels of **100ppm and higher** are considered immediately dangerous to life and health (IDLH), and it is important to urgently escape the contaminated environment.

This is the concentration where exposure is likely to:

- cause death, or
- cause irreversible or delayed adverse health effects, or
- interfere with an individual's ability to escape from the dangerous conditions (for example, severe eye or respiratory irritation).

In some situations, the detected level of hydrogen sulphide may initially be low, but be increasing at a fast rate.

IDLH values are established to:

- ensure workers can escape from a contaminated environment if respiratory protective equipment fails
- indicate a maximum level where if levels are any higher, workers require a highly reliable breathing apparatus to provide maximum protection.

³ WorkSafe New Zealand would like to thank WorkSafe British Columbia for the use of their table.

⁴ 1ppm = 1 part of gas per million parts of air by volume.

⁵ Similar to mild conjunctivitis.

4.0

How can you tell if your workers are at risk from hydrogen sulphide?

How can monitoring be used?

You must manage the health risks to workers and others that arise from being exposed to the work carried out by your business. In some circumstances, this could mean monitoring worker exposure (exposure monitoring) and monitoring the health of workers (health monitoring).

Monitoring is not a control measure. It does not replace the need for control measures to minimise worker exposure to harm.

You must engage with your workers when making decisions about monitoring. For more information, see WorkSafe's webpage [Exposure monitoring and health monitoring – guidance for businesses](#)

How can you use exposure monitoring to tell you if workers are being exposed to hydrogen sulphide?

Exposure monitoring:

- will tell you the concentrations of hydrogen sulphide your workers are exposed to during all or part of their work shift, and if all your control measures are working properly
- can involve measuring the amount of substance in the air or in workers' blood, and having qualified people interpret the values and assess the risk of exposure to ensure it is managed
- should be carried out by suitably qualified, trained and experienced people (such as occupational hygienists).

If you need help with exposure monitoring, see WorkSafe's good practice guidelines [Exposure monitoring and health monitoring](#) or talk to an occupational hygienist.

Providing gas detectors for workers

Gas detection provides an indication of the gas levels in the atmosphere and is used to indicate when to put in other control measures, like removing workers from that environment.

Using a gas detector is not a substitute for exposure monitoring, which should only be carried out by a competent person, such as an occupational hygienist. You should provide workers with gas detectors fitted with an adequate hydrogen sulphide sensor, so they can tell if the gas is present and at what level. The detector sounds an alarm to warn workers in the immediate environment if gas levels reach a pre-set value. The detector can be carried by a person or it can be kept in a fixed location.

You should have a written gas detection programme that covers the selection, use, storage, and maintenance of the system. You should consider what type of gas detection is suitable (fixed or personal) for the exposure risk. You may need to seek specialist advice from a competent and qualified person, such as an occupational hygienist. For more information about where to get specialist help, see Section 7: *More information*.

Only use gas detectors in accordance with the manufacturer's directions, including when checking that the sensors are working prior to use (bump testing) and regular calibration.

Workers and supervisors should be trained in:

- the correct use, storage and maintenance of the gas detector, and
- the correct procedures for safely operating in and withdrawing from an area where hydrogen sulphide may be present.

Workers should raise any questions with their supervisors or health and safety representatives.

If hydrogen sulphide is regularly detected at your work, you should revisit the risk assessment for the task and review your control measures.

5.0

How can you manage the risks of hydrogen sulphide?

Strong worker engagement, participation, and representation leads to healthier and safer work.

Workers are also good for business performance and productivity because they help inform better decisions. Workers who help shape safer work systems can suggest practical, cost-effective solutions. They are more likely to make these systems happen in practice.

A PCBU must engage with and enable the participation and representation of workers. A PCBU should regularly discuss health and safety issues at work with their workers.

As a PCBU you must ensure, so far as is reasonably practicable, that the health and safety of workers and other people is not put at risk from your work.

Eliminate the risks

Consider how to eliminate the risks of exposure to hydrogen sulphide. For example, remove the conditions (such as rotting organic material) that may lead to the production of hydrogen sulphide.

You must eliminate risks that arise from your work, so far as is reasonably practicable. If it is not possible to eliminate risks, you must minimise them, so far as is reasonably practicable.

Minimise the risks

If the risks cannot be eliminated, you must minimise them so far as is reasonably practicable.

You must make sure:

- containers of hazardous substances and wastes are clearly and accurately labelled. For more information, see WorkSafe's webpage [Labelling, decanting and repackaging hazardous substances](#)
- hazardous substances and wastes are safely handled, stored and disposed of
- workers have been trained in the health effects of hydrogen sulphide and how to minimise their exposure
- workers that are working in areas where hydrogen sulphide is present are adequately supervised by a person who is trained in and familiar with the emergency plan. In some instances, this may require a fully trained standby worker.

You must engage with your workers when considering how to minimise risks. When assessing the risks, consultation with subject matter experts is recommended to help determine risks and control measures for your industry. For example, consulting a competent and qualified person like an occupational hygienist.

With your workers:

- identify when workers or other people may be exposed to hydrogen sulphide. For example, certain work tasks may increase the risks of exposure, or hydrogen sulphide could be generated when substances are combined accidentally or during certain tasks. It is important to understand the risks or likelihood of exposure, and plan work tasks
- use the hierarchy of control measures to select the appropriate level of control measures to minimise exposure to hydrogen sulphide. For example, where possible isolate workers from areas where hydrogen sulphide is generated. Or put in place engineering control measures such as local exhaust ventilation to remove hydrogen sulphide gas from the work area
- give preference to control measures that protect many workers at the same time. Personal protective equipment (PPE) is the least effective control measure. It only protects the person wearing it. PPE should not be the first or only control measure you consider.

You should also provide workers with well-maintained and calibrated personal gas detectors, and make sure workers are trained to use them correctly.

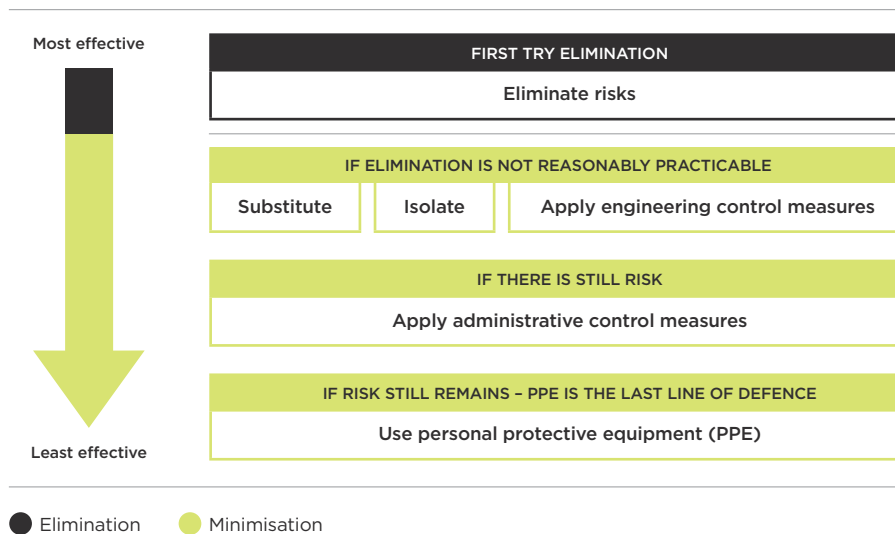


FIGURE 1:
Hierarchy of control measures

Respiratory protective equipment (RPE)

The type of respirator you choose will depend on the results of your risk assessment, control measures, and the level of hydrogen sulphide.

Always choose a respirator that:

- fully protects the worker
- conforms with *AS/NZS 1716 Respiratory protective devices*
- is selected in accordance with *AS/NZS 1715 Selection, use and maintenance of respiratory protective devices*.

Supplied air respiratory protection should be used where the concentrations of hydrogen sulphide may reach a level of immediate danger to life and health. Consider having sufficient supplied air systems available for use as part of your emergency plan (for example, a supplied air emergency escape device or self-contained breathing apparatus (SCBA)).

Carry out fit testing for each worker who will wear a respirator that requires a seal against the face.

Provide information, training and instruction so workers can correctly use, wear, store and maintain their RPE. For more information, see WorkSafe's webpage [RPE guidance for businesses and workers](#)

Put control measures in place

As soon as possible after a decision is made about the control measures, a PCBU should:

- put the control measures in place
- instruct and train workers (including new workers) about the control measures, including why it is important to use them and how to apply them
 - if new processes are introduced or processes change, workers should also receive training and an explanation of these.

Train your workers

You must ensure, so far as is reasonably practicable, the provision of any information, training, instruction, or supervision that is necessary to protect all persons from risks to their health and safety arising from work.⁶

For more information, see WorkSafe's webpage [Information, instruction, supervision and training when handling hazardous substances](#)

Have an emergency plan

You must prepare, implement and maintain an emergency plan for your work.⁶

Your plan must include what to do if there is an emergency involving hazardous substances (for example, hydrogen sulphide).

You must make sure workers are trained in, and familiar with, the emergency plan. Workers should raise any questions with supervisors or health and safety representatives.

For more information, see WorkSafe's webpage [Managing your hazardous substances – Emergency plans](#)

Evacuate and stay out

As part of your emergency plan, you should have an evacuation process.

You should not re-enter an area if you have not confirmed with a competent person (for example, a firefighter in charge of the incident) that the concentration of hydrogen sulphide is not harmful, and it is safe to do so.

⁶ Health and Safety at Work (General Risk and Workplace Management) Regulations 2016, regulation 14.

Do not attempt to rescue others by entering the contaminated environment without the proper equipment

An emergency plan should include a rescue plan, including having the right equipment on site and workers being trained in its use. It is recommended to practice the rescue plan before carrying out work where there is potential exposure to hydrogen sulphide.

Notify WorkSafe of incidents

Notify WorkSafe if you have an uncontrolled release of hydrogen sulphide because this is a notifiable incident. Call 0800 030 040 or see our website: [worksafe.govt.nz](https://www.worksafe.govt.nz)

For more information, see WorkSafe's webpage [Notifying WorkSafe - what events need to be notified?](#)

6.0

Review and improve control measures

Control measures should remain effective, be fit-for-purpose, be suitable for the nature and duration of the work, and be used correctly.

With your workers, regularly monitor control measures to confirm that the measures are effective. The risks of exposure to hydrogen sulphide must be regularly reviewed, and also reviewed following a potential or actual exposure incident.

How can you use health monitoring to tell you if your control measures are effectively managing the risk?

Health monitoring can tell you if workers are experiencing health effects from potential exposure to hydrogen sulphide.

It involves monitoring workers to identify any changes to their health status because of what they are being exposed to.

Health monitoring should be carried out by suitably qualified, trained and experienced health practitioners (such as an occupational health nurse), who will advise you on the appropriate health monitoring. You must have worker's consent before you monitor their health.

If you need help with health monitoring, see WorkSafe's good practice guidelines [Exposure monitoring and health monitoring](#) or talk to an occupational health nurse or occupational physician.

7.0

More information

Specialist help

Occupational hygienists

[New Zealand Occupational Hygiene Society](#)

Occupational nurses

[Australian and New Zealand Society of Occupational Medicine](#)

[New Zealand Occupational Health Nurses' Association](#)

Registered health and safety professionals

[Health and Safety Association of New Zealand \(HASANZ\)](#)

WorkSafe special guide

[Workplace exposure standards](#)

Disclaimer

This publication provides general guidance. It is not possible for WorkSafe to address every situation that could occur in every workplace. This means that you will need to think about this guidance and how to apply it to your particular circumstances.

WorkSafe regularly reviews and revises guidance to ensure that it is up-to-date. If you are reading a printed copy of this guidance, please check worksafe.govt.nz to confirm that your copy is the current version.

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