Workplace exposure standards for airborne contaminants

What are Workplace Exposure Standards?

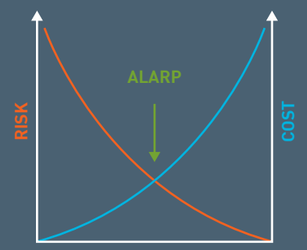
Workplace exposure standards (WESs) represent the airborne concentrations of particular substances or mixtures that must not be exceeded to protect the health of workers. They are based on the airborne concentrations of individual substances, which, according to current knowledge, should not cause adverse health effects nor undue discomfort to nearly all workers.[1]

Exposure standards do not identify a dividing line between a healthy or unhealthy working environment. Natural biological variation and the range of individual susceptibilities mean some people might experience adverse health effects below the exposure standard. Therefore, exposure standards should not be considered as representing an acceptable level of exposure to workers. They establish a statutory maximum upper limit. All reasonably practicable steps must be taken to eliminate or minimise exposure to a level well below the exposure standard.

Note that there are also exposure standards that pertain to other hazards, such as noise and radiation, however, these are outside the scope of this information sheet.

Regulatory requirements

Regulation 49 of the Work Health and Safety (Mines) Regulations 2022[2] outlines that the mine operator must ensure that no person at the mine is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.



Regulation 50 outlines that the mine operator must ensure that air monitoring is carried out to determine the airborne concentration of a substance or mixture at the mine to which an exposure standard applies if:

a. the mine operator is not certain on reasonable grounds whether or not the airborne concentration of the substance or mixture at the mine exceeds the relevant exposure standard; or
b. monitoring is necessary to determine whether there is a risk to health.

Furthermore, the mine operator must ensure that the results of air monitoring carried out are recorded and kept for 30 years after the date the record is made and are readily accessible to persons at the workplace who may be exposed to the substance or mixture (r50).

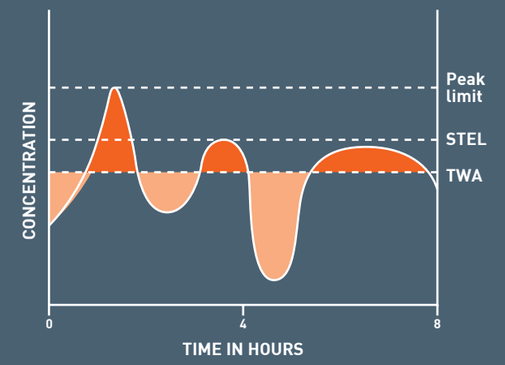
In addition, r635A states that an operator of a mine must ensure that the concentration of any airborne contaminant at the mine is as low as is reasonably practicable.

Types of Workplace Exposure Standards

There are three types of WESs:

- **8-hour time weighted average (TWA)** – maximum average airborne concentration of a substance when calculated over an 8-hour working day for a 5-day working week.
- **Short term exposure limit (STEL)** – a time-weighted average maximum average airborne concentration of a particular substance permitted over a 15-minute period. Exposures at STEL must not be longer than 15 minutes and must not occur more than 4 times per day. There must be at least 60 minutes between successive exposures.
- **Peak** – a maximum or peak determined over the shortest analytically practicable period of time not exceeding 15 minutes. Excursions above the peak limit are not permitted at any time because to do so would expose a person above the exposure standard for that substance.

WESs can be found on the Safe Work Australia Hazardous Chemical Information System (HCIS) website or in the Safe Work Australia *Workplace Exposure Standards For Airborne Contaminants* document.[3]



From the 1st of December 2026, the Workplace Exposure Standards (WES) for airborne contaminants will be renamed Workplace Exposure Limits (WELs) for airborne contaminants. This change has been made to communicate that the values are limits not to be exceeded and to align Australia with language used internationally.

Note that some exposure standards are referenced explicitly within the Work Health and Safety (Mines) Regulations 2022 – for example, inhalable dust and respirable dust (r49) and diesel particulate (r656B).

Acute vs chronic

It is essential to understand the nature of the chemical substances present in the workplace as they do not all behave the same, and some present higher risks than others.

Some chemicals are acute in nature, where the health effects are observed immediately or soon after exposure (usually within the shift). Examples of acute health effects include dizziness and skin or throat irritation. Often, the symptoms subside; however, permanent damage or even death can occur from a significant, single exposure. An example of an acute health impact would be hydrogen sulphide and loss of consciousness.

Other chemicals may seem innocuous but chronic exposures (exposures over long periods of time) may eventuate in health impacts in years to come. Symptoms don't usually subside when the exposure stops for chronic health hazards. An example of a chronic health impact would be asbestos exposure and mesothelioma/cancer.

Extended shifts

Workplace exposure standards have been developed for conventional work shifts of five consecutive 8-hour work days, followed by two days off (40-hour work week).

Deviations from this traditional shift pattern are now normal within the mining industry, and the potential for increased periods of contaminant exposure needs to be addressed. This is achieved through appropriate adjustment of 8-hour time-weighted exposure standards to compensate for the additional time exposed and reduced recovery time between shifts.[4]

In Western Australia, DEMIRS has endorsed the Québec Model as the extended work shift exposure standard adjustment in the WA mining industry. Further information is provided in the DEMIRS publication *Adjustment of atmospheric contaminant exposure standards – guide*.

Health Management Plans (HMPS) and WESs

Regulation 675EA outlines that mine operators have a duty to prepare and implement a HMP. The HMP provides a systematic process for managing agents at all stages of the mining operation. It documents how hazards are controlled and what methods are used to verify that controls are effective. An airborne contaminant monitoring programme that outlines a monitoring schedule against applicable airborne contaminants is an integral part of the HMP. Further information can be obtained from the DEMIRS publication *Preparation of a health and hygiene management plan – guide*.

Air monitoring must be conducted by a competent person, such as an appropriately qualified Mine Air Quality Technician under the guidance of a Mine Air Quality Officer and/or an appropriately qualified Occupational Hygienist. The monitoring must be conducted within the breathing zone of the worker and outside of any respiratory protection worn.

The hygienist will use their expertise and judgement to design an appropriate air monitoring strategy that considers the nature and duration of the process, the nature of the airborne contaminant, sampling and analysis errors, and the required statistical significance of the data set derived.

Determination of compliance often requires the collection of a number of exposure measurements, often involving a number of workers selected at random to remove bias and increase the representativeness of the data collected.

Statistical analysis is undertaken, and a decision statistic is used for comparison against the workplace exposure standard.

Details of all samples taken as part of a HMP monitoring plan must be uploaded to the DEMIRS Safety Regulation System (SRS). Further investigation and actions to improve controls must be documented in SRS following an exceedance of a WES.[5]

Exposure routes and risk factors

One of the main exposure routes for chemical substances is inhalation, where chemicals can directly impact the nose, air passages and lungs directly (local impact), or be absorbed into the bloodstream and impact elsewhere (systemic impact). Exposure can also be by ingestion, skin/eye contact or more unusually injection (e.g. high pressure fluid pushing the contaminant into the skin). While some substances can act directly on the skin/eye, others can penetrate intact skin and be absorbed into the body.

Some substances can cause sensitisation and create more significant risks to sensitised workers, whereby they react to levels of the substance well below the corresponding WES.

When exposed in combination, some substances have synergistic effects, whereby the total health impact is greater than the sum of the effects from each substance. Other substances have potentiation effects, where one (innocuous) chemical enhances the toxic effect of the other chemical.

Besides the type of chemical/s to which a worker is exposed and the exposure route, other factors may impact exposure risk:

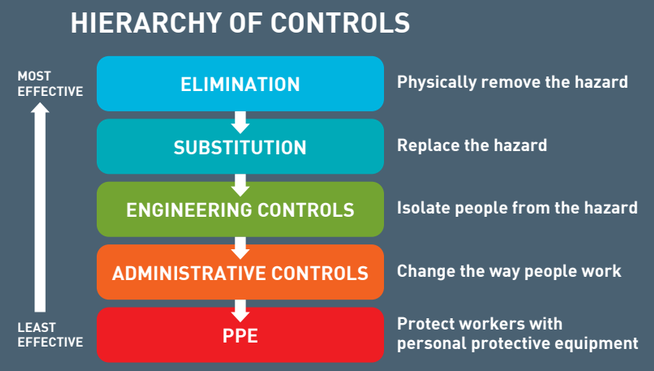
- form or chemical and particle size (if relevant)
- concentration
- duration of exposure
- work rate/breathing rate,
- personal factors (e.g. age, smoking status, medication, susceptibility, etc)

Controlling exposures to airborne contaminants

Regulation 36 of the Work Health and Safety (Mines) Regulations 2022 outlines that where it is not possible to eliminate risks to health and safety, mine operators must minimise risks, so far as is reasonably practicable, using the hierarchy of control.[6]

The WHS Regulations require duty holders to work through the hierarchy of control measures when managing risk. The hierarchy ranks control measures from the highest level of protection and reliability to the lowest.

Respiratory protective equipment (RPE) should be considered the last line of defence. It is essential that workers are clean shaven, trained and fit-tested to ensure the required protection is given from the RPE worn.



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Resources and further information

1 DMIRS (2019) Adjustment of atmospheric contaminant exposure standards – guide
2 Western Australian (2022) Work Health and Safety (Mines) Regulations
3 Safe Work Australia (2024) Workplace Exposure Standards for Airborne Contaminants
4 AIOH (2019) Occupational Hygiene Monitoring & Compliance Strategies
5 DMIRS (2018) Preparation of a Health and Hygiene Management Plan
6 Safe Work Australia (2023) Code of Practice: Managing risks of hazardous chemicals in the workplace