SPECIAL GUIDE

Workplace exposure standards and biological exposure indices

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WORKSAFE
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Preface

The twe fth edition of the Workp ace Exposure Standards and Bio ogica Exposure ndices has been deve oped by Worksafe New Zea and (WorkSafe). nput has a so been sought from a wide range of interested parties.

This edition supersedes a previous editions and versions.

Worksafe wi continue to review and revise this document to take into account any significant new toxico ogica or occupationa hygiene information.

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45	Tab e 5 D oxane	Change of WES-TWA to 5ppm	The WES-TWA of 5ppm [18mg/m^3] s set to prevent ncreased nuc ear en argement n the resp ratory and o factory ep the a, wh ch w prevent the deve opment of nasa tumours as we .
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60	Table 5 Phenol	Change of WES-TWA to 1ppm Introduction of WES-STEL 2ppm	The WES-TWA of 1ppm includes a safety factor for a non-carcinogenic endpoints, based on the point that 5% of workers exposed up to 5ppm indicated potential kidney damage and the 5ppm NOAEL from experimental animals. The WES-STEL of 2ppm is set to be protective against peak concentrations triggering acute upper respiratory tract irritation.
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66	Table 5 Synthetic mineral fibres	Change of WES-TWA to 2mg/m^3 for non-carcinogenic SMFs Change of WES-TWA to 0.3f/ml for carcinogenic SMFs	There was a need to set WES for SMF based on its carcinogenicity. A WES-TWA of 2mg/m^3 is set for non-carcinogenic SMFs to be protective against upper respiratory tract irritation. A WES-TWA of 0.3f/ml for carcinogenic SMFs is considered a NOAEL based on the average cumulative exposures, after 45 years, of 147.9 and 184.8f-mo/ml, respectively, resulting in an average fibre concentrations of 0.27 and 0.34f/ml.
67	Table 5 Thiram	Introduction of (dsen) notation	
68	Table 5 *p*-Toluidine	Introduction of (dsen) notation	
70	Table 5 Turpentine (wood $C_{10}H_{16}$)	Introduction of (dsen) notation	
70	Table 4 Vanadium, as V, and its inorganic compounds, except Cl pigment yellow 184	Interim WES-TWA 0.05mg/m^3, as V (V) for V and its inorganic compounds, except Cl pigment yellow 184. Propose to review WES again in the future.	The WES-TWA is set to be protective against all non-carcinogenic and non-genotoxic endpoints, based on a NOAEL of 0.01 to 0.04mgV/m^3 from exposed workers, and the expectation that all inorganic vanadium compounds can convert to active vanadium ions in biological matrices. There is evidence that vanadium pentoxide was carcinogenic in test species, mutagenic and exhibited reproductive toxicity. Therefore, a further review for a WES to reduce the risk of cancer is recommended.

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70	Table 5 Vinyl acetate	Interim WES-TWA 5ppm Interim WES-STEL 10ppm Propose to review WES again in the future.	The WES-TWA is set to be protective against a non-carcinogenic endpoints and below concentrations where metabolites acetic acid and acetaldehyde become toxicologically significant in phenotypically normal individuals, and is based on half the value of the WES-STEL. The WES-STEL is set to be protective against respiratory or ocular irritation in most workers based on limited observations in humans of a NOAEL for irritancy at 10ppm. There is evidence that vinyl acetate was carcinogenic and mutagenic in test species. Therefore, a further review for a WES to reduce the risk of cancer is recommended.
71	Table 5 Vinyl cyanide (Acrylonitrile)	Introduction of (dsen) notation	
73	Table 5 Zinc chromates, as Cr	Removal of entry	See Chromium (VI) compounds, as Cr
73	Table 5 Zinc oxide	Change of WES-TWA to 0.1mg/m³ (R) Introduction of WES-STEL 0.5mg/m³ (R) Change of WES-TWA to 2mg/m³ (I) Change of WES-STEL to 5mg/m³ (I)	A WES-TWA of 0.1mg/m³ (R) is set to be protective against systemic inflammatory parameters, extrapolated from a NOAEC of 0.4mg/m³ after 2 hours exposure by volunteers. A WES-STEL of 0.5mg/m³ (R) is set to be protective against peak concentrations triggering acute irritation responses. A WES-TWA of 2mg/m³ (I) is set to be protective against compromised lung function or asthmatic symptoms, based on an exposures of 2.5–4.6mg/m³ from a study in smelter workers. A WES-STEL of 5mg/m³ (I) is set to be protective against peak concentrations triggering acute asthmatic symptoms.
81	Table 5.2 Table of BEI values – Arsenic	Change to 15µg As/L sum of inorganic As compounds and its metabolites (MMA and DMA) in urine	Based on regression lines from a study by Apostoli et al. (1999), an airborne concentration of 0.001mg/m³ correlates with 15µg/L as the sum of As(III), AsV, MMA and DMA in urine.
81	Table 5.2 Table of BEI values – Benzene	Change to 2µg/g creatinine S-PMA in urine	The BEI corresponds to the WES-TWA of 0.05ppm.
81	Table 5.2 Table of BEI values – Cadmium	Change to 2µg Cd/g creatinine in urine Removal of cadmium in blood BEI	The BEI is a LOAEL for renal effects and corresponds to the WES-TWA of 0.004mg/m³ (R).
83	Table 5.2 Table of BEI values – Phenol	Change to 100mg/L total phenol in urine	The BEI corresponds to the WES-TWA of 1ppm.

Obligations and rights under the Health and Safety at Work Act 2015 (HSWA) and Health and Safety at Work (General Risk and Workplace Management) Regulations 2016

What are the obligations of a person conducting a business or undertaking (PCBU)?

PCBUs must ensure the health and safety of workers doing work for the PCBU and to ensure the health and safety of others whose work is influenced or directed by the PCBU.

PCBUs must also ensure that the health and safety of other persons is not put at risk from the work carried out as a part of the PCBU's business or undertaking.

To achieve this, PCBUs must (so far as is reasonably practicable):

- identify hazards that might give rise to risks to health and safety
- eliminate risks to health and safety
- minimise risks that are not reasonably practicable to eliminate
- provide and maintain a work environment that is without risks to health and safety
- provide and maintain safe plant and structures
- provide and maintain safe systems of work
- ensure the safe use, handling and storage of substances
- provide adequate and accessible facilities for the welfare of workers doing work for the PCBU
- provide the information, training, instructions or supervision necessary to protect all persons from risks arising from work carried out as a part of the conduct of the business or undertaking
- ensure that the health of workers at the workplace is monitored
- ensure that the conditions at the workplace are monitored
- provide adequate and accessible first aid facilities for workers
- provide suitable personal protective equipment and clothing for workers and other persons and ensure that it is used
- engage with workers so workers have a reasonable opportunity to raise health and safety issues and to contribute to the decision-making process.

Do workers and others have obligations and rights?

Yes. Workers and other persons at a workplace are required to take reasonable care to ensure their health and safety and the health and safety of others who are there. This includes considering both the things they do and the things they omit to do (such as not using safety equipment or appropriate exposure controls). They are also required to comply with any reasonable health and safety instruction given by the PCBU.

Workers are also required to co-operate with any reasonable health or safety policy or procedure of the PCBU.

Although it is the PCBU's overall responsibility to ensure a safe working environment, workers do have a responsibility to use the exposure controls and safety equipment provided, and to wear protective clothing as appropriate.

Workers and others should also report to the PCBU any risks or incidents they become aware of so the PCBU can investigate and put safeguards in place.

Workers are entitled to receive, free of charge, protective clothing and equipment if this is necessary to protect them from health and safety risks in the workplace.

Workers are entitled to:

- receive information, supervision, training, and instruction appropriate to the work they are doing, the plant they are using, and the substances they are handling so they can do their job in a safe and healthy manner
- wear their own suitable personal protective clothing and equipment, but the PCBU must ensure that any such clothing and equipment is suitable
- have access to the results of exposure monitoring at the workplace where they may be, or may have been exposed to the health hazard, provided that the exposure monitoring results do not contain any information that identifies or discloses anything about an individual worker
- be provided with a copy of any health monitoring report relating to health monitoring of the worker
- receive reasonable opportunities to participate in workplace health and safety

For further information on health and safety rights and responsibilities in the workplace visit: worksafe.govt.nz

Part One

WORKPLACE EXPOSURE STANDARDS FOR AIRBORNE CONTAMINANTS

1.0 Explanation of workplace exposure standards (WES)

IN THIS SECTION:

1.1 Introduction

Target audience

The Workplace Exposure Standards (WES) are intended to be used as guidelines for health risk management.

PCBUs and people with duties under HSWA and the HSNO Act may use this book as a reference; but it is recommended that specialist advice is sought prior to engaging in monitoring programmes or exposure control.

It is not recommended that untrained persons use WES to determine 'compliance'. Professional judgement is required in making decisions regarding safe levels of exposure to chemical and physical agents found in the workplace.

Legal requirements

WES are an important tool for monitoring the workplace environment. Where hazardous or toxic substances exist in the same environment as workers, and the PCBU is unable to successfully eliminate these substances from working environments, they are required to minimise and monitor worker exposure. The PCBU must also, so far as is reasonably practicable, ensure that the health of workers and the conditions at the workplace are monitored for the purpose of preventing injury or illness of workers arising from the conduct of the business or undertaking.

Section 36 of HSWA requires PCBUs to ensure worker health and safety 'so far as is reasonably practicable'. That duty requires the PCBU to eliminate risks to health and safety, so far as is reasonably practicable. If it is not reasonably practicable to do so, the PCBU must minimise the risks so far as is reasonably practicable. If a PCBU is uncertain on reasonable grounds whether the concentration of a substance exceeds the relevant prescribed exposure standard, regulation 30 of GRWM Regulations requires the PCBU to conduct exposure monitoring to determine the concentration of the substance. Regulation 32 of the GRWM Regulations requires the PCBU to make the results of exposure monitoring available to any person in the workplace who may have been exposed to the health hazard provided that no information that identifies an individual worker is disclosed. A prescribed exposure standard is a workplace exposure standard or a biological exposure index that has the purpose of protecting persons in a workplace from harm to health and that is prescribed in:

a. Regulations

b. A safe work instrument.

Regulation 8 of the GRWM Regulations requires the PCBU to review and, as necessary, revise control measures if the results of exposure monitoring carried out under regulation 30 determine that the concentration of a substance hazardous to health at the workplace exceeds a relevant prescribed exposure standard.

In workplaces where a worker is carrying out ongoing work involving a substance that is hazardous to health that is specified in a safe work instrument as requiring health monitoring, regulation 31 of the GRWM Regulations requires the PCBU to ensure that health monitoring is provided to the worker if there is a serious risk to the workers' health because of exposure to the substance. Regulation 39 requires the PCBU to give results of health monitoring of a worker to that worker.

Limitations

Defining an exposure level that will achieve freedom from adverse health effects is the major consideration for assigning these WES. However, compliance with the designated WES level does not guarantee that all workers are protected from discomfort or ill-health. The range of individual susceptibility to hazardous and toxic substances is wide, and it is possible that some workers will experience discomfort or develop occupational illness from exposure to substances at levels below the WES.

WES must not be used to differentiate between safe and inherently hazardous exposure levels. In addition, the numerical value of two or more WES must not be used to directly compare the relative toxicity of different substances as the biological potency and toxicologic effects used to derive a WES are specific to each substance.

When interpreting the risk posed by individual substances, the documentation that supports the WES should be consulted.

When applying these WES values it is important to understand the end-point health effects for which it is designed to protect for, and the limitations of the WES or data used to derive the value. It is good practice to consider WES values from other organisations that could be more appropriate to apply for the purposes of managing health risk. Relevant sources of other exposure standards include the Gestis substance database, the ACGIH®, SCOEL, ECHA, DFG, DECOS, and Safe Work Australia.

Substances without a WES

In many cases well-documented data exist to help determine WES. But for some substances, the available toxicological and industrial hygiene information is insufficient to enable highly reliable standard-setting. As such some substances do not have WES. If a substance doesn't have a WES, this should not be taken to mean that it is safe under all conditions, and that no restriction should be placed on its use. Regardless of the substance, it is important to eliminate or minimise the concentration of airborne substances as far as is reasonably practicable.

Substances without a WES-STEL

To provide an upper limit on short-term exposures, an excursion limit (EL) may be applied for substances that have a WES-TWA, but no WES-STEL or WES-Ceiling. Before applying an EL, further information should be obtained to help inform whether or not doing so is an appropriate approach, rather than assuming it to be appropriate for all substances. Such information may include acute toxicological data or the existence of short-term exposure limits from other jurisdictions.

Routes of entry

Hazardous or toxic substances may enter the body following inhalation, ingestion or skin absorption. But in occupational settings, it is most often the inhalation aspect that is most important, in terms of exposure however this is substance dependent.

Substances listed with a skin notation (skin) are known to have potential for significant skin absorption particularly from liquid, but potentially also from vapour. This should not be ignored, because in these cases the total dose received through all absorption routes can be significantly higher than just that from inhalation (such as might be estimated from the airborne level). This is further discussed in the section on skin absorption (Section 1.8).