Workplace Exposure Standards

EFFECTIVE FROM 2002

OCCUPATIONAL SAFETY & HEALTH SERVICE
TE RATONGA ORANGA

DEPARTMENT OF LABOUR
TE TARI MAHI

Published by the Occupational Safety and Health Service
Department of Labour
Wellington
New Zealand
www.osh.dol.govt.nz

First published: November 1994
Revised: January 2002

Price: $10 (incl. GST)

ISBN 0-477-03660-0

OSH 2050

Preface

The Workplace Exposure Standards contained in this publication have been endorsed by the Occupational Safety and Health Service (OSH) of the Department of Labour.

In all cases it is expected that employee exposure to hazardous substances will be controlled to a level as far below the relevant Workplace Exposure Standard as practicable by applying the hierarchy of control required by the Health and Safety in Employment Act 1992. This hierarchy of elimination, isolation and minimisation as it applies to hazardous substances is explained more fully in the *Approved Code of Practice for the Management of Substances Hazardous to Health*[1].

An environmental and/or biological monitoring programme provides a convenient means of assessing the quality of the environment in the workplace but this is only one facet of the comprehensive approach that should be taken. Education and training, engineering control, administrative control, protective equipment and medical surveillance are all elements that should be considered in an integrated occupational health programme.

Another caution should be sounded about the use of workplace exposure standards. For many substances, the levels of exposure that are now considered acceptable will in the future be found to be excessive. As the scientific data on the toxic effects of substances have grown, many exposure standards have been reviewed, generally being lowered not raised. It is stressed that the primary consideration should be to avoid exposure to substances that may be harmful to health and where this is not possible to reduce the exposure to the lowest practicable level. Workplace exposure monitoring or biological exposure monitoring may be used to establish that the lowest practicable level has been achieved. It is recognised that the health risks presented by occupational exposure to some substances cannot be completely eliminated, and that some residual risk will remain even after reasonable precautions have been taken.

In preventing or controlling exposure to substances that may be harmful to health, substitution with a less hazardous substance and the provision of engineering control are preferred to the use of personal protective equipment. Respirators do, however, provide a means of reducing unnecessary exposure. Their routine use should, in particular, be encouraged as a means of providing additional protection for short periods of increased exposure.

Often, factors apart from occupational exposure will contribute to the development of work-related disorders. A worker's susceptibility may be influenced by genetic factors, age, state of health, exposure outside of the workplace, smoking, and alcohol or other drug usage. Ultimately, it is the health of the

individual worker that is to be protected, and we must ensure that procedures that are designed to meet the average response remain flexible.

The Workplace Exposure Standards will be reviewed annually, with changes and additions being made available electronically. The most up-to-date list of the Workplace Exposure Standards and Biological Exposure Indices can be downloaded from the OSH web site www.osh.dol.govt.nz

Contents

Workplace Exposure Standards for Atmospheric Contaminants

1. Introduction

The Workplace Exposure Standards set out in this section are intended to be used as guidelines for those involved in occupational health practice. The use of the standards by untrained persons as a marker in determining "compliance" is not recommended. In assigning the standards, defining a level that will achieve freedom from adverse health effects is the major consideration. Compliance with the designated value does not, however, guarantee protection from discomfort or possible ill-health outcomes for all workers. The range of individual susceptibility is wide and it is possible that workers will experience discomfort or develop occupational illness from exposure to substances at levels below the exposure standards.

Approximately 700 substances have been assigned standards. While in many cases well-documented data exist, for some substances the toxicological and industrial hygiene information that is available does not provide the solid platform desired for standard-setting. It is inevitable that some current exposure standards will be lowered in the future. The workplace exposure standards are not to be used to differentiate between exposure levels that are safe for all workers and those that are inherently hazardous. The relationship between the numerical value of two exposure standards cannot be used as a measure of relative toxicity. Apart from any inconsistency that may have resulted from the amount of information that was available at the time the different standards were set, the biological basis for assigning the standards also varies. Some standards are designed to prevent the development of ill-health after long-term exposure; others to reduce the possibility of acute effects. Further, the technical feasibility of limiting exposure varies from substance to substance and in practice this may restrict the safety factor that can be realized.

Many substances that may be encountered in the workplace have not been assigned exposure standards. This should not be taken as an indication that these substances are safe and that no restriction need be placed on their use. Regardless of the standard, it is important to take all reasonable steps to reduce the concentration of airborne substances to the lowest practicable level.

While substances hazardous to health may enter the body following inhalation, ingestion or skin absorption, it is usually the inhalation component that is most important. Substances listed with a skin notation are known to have the potential for significant skin absorption. This should not be ignored, as the total dose received may be higher than that suggested by the airborne level. This is further discussed in the section on skin absorption.

Exposure to airborne substances is usually measured directly with personal air sampling techniques but in some situations biological monitoring may be used as a complementary approach. An introduction to biological monitoring and a list of recommended indices may be found in the second part of this publication.

2. Workplace Exposure Standards: Definitions

Substances encountered in the workplace may be acutely hazardous or the effects may only be noted after long-term exposure has resulted in an accumulation of the substance in the body. For substances that produce chronic effects and have long half-times in the body it is generally sufficient to control the mean exposure, but if acute effects are involved it is also necessary to control fluctuations in the levels by limiting short-term exposures.

The following categories of Workplace Exposure Standards are defined:

Workplace Exposure Standard – Time Weighted Average (WES-TWA*).* *The time-weighted average exposure standard designed to protect the worker from the effects of long-term exposure.*

Workplace Exposure Standard – Ceiling (WES-Ceiling). *A concentration that should not be exceeded during any part of the working day.*

Workplace Exposure Standard – Short-Term Exposure Limit (WES-STEL). *The 15-minute average exposure standard.* Applies to any 15-minute period in the working day and is designed to protect the worker against adverse effects of irritation, chronic or irreversible tissue change, or narcosis that may increase the likelihood of accidents. The WES-STEL is not an alternative to the WES-TWA; both the short-term and time-weighted average exposures apply.

General Excursion Limit. Often there is insufficient toxicological data available for the establishment of a Short Term Exposure Limit. Peak exposure should however still be controlled even in situations where the Time-Weighted Average level is not exceeded. A 15-minute exposure limit of three times the TWA is recommended. Where a STEL has been assigned, the STEL value takes precedence over the general excursion regardless of whether or not it is a stricter standard.

In all instances the Workplace Exposure Standards relate to exposure that has been measured by personal monitoring using procedures that gather air samples in the worker's breathing zone. The breathing zone is defined as a hemisphere of 300mm radius extending in front of the face and measured from the midpoint of an imaginary line joining the ears.

3. Workplace Exposure Standards: Application and Corrections

The Workplace Exposure Standards have been derived assuming a normal work pattern of an eight-hour working day, five days a week. In some instances a correction is required to take into account other work patterns. The following rules should be applied when designing monitoring programmes and assessing the results against the Workplace Exposure Standards.

A. The substance has a WES-Ceiling or a WES-Short-Term Exposure limit assigned

Where a WES-Ceiling or WES-STEL has been assigned, no adjustment is required. The exposure level is compared directly with the WES-Ceiling or WES-STEL value.

Example 1

Substance: hydrogen cyanide

WES-Ceiling: 10ppm

Workshift: 12 hours

Exposure: Maximum instantaneous exposure level 8ppm.

The peak exposure level during the shift of 8ppm is compared directly with the WES-Ceiling of 12ppm. The WES has not been exceeded.

B. The substance has a WES-TWA assigned and the total exposure during the workday is 8-hours or less.

For exposures up to eight hours the average exposure over the time worked is compared directly with the Workplace Exposure Standard-Time-Weighted Average (WES-TWA). If a Ceiling or STEL has not been assigned then the default excursion of three times the WES for any 15-minute period applies.

This is illustrated in the following example:

Example 2

Substance: Toluene

WES-TWA: 50ppm

Workshift : 8 hours

Exposure: 60ppm averaged over the 8 hours including a 15-minute exposure of 200ppm

The WES-TWA has been exceeded as the average exposure during the workshift was greater than 50ppm. The general excursion that applies over any 15-minute period, 150ppm (3 times the WES-TWA of 50ppm), has also have been exceeded.

C. The substance has a WES-TWA assigned and the total exposure during the workday is greater than 8 hours

An adjustment is made to the Workplace Exposure Standard by applying the following formula based on the Brief and Scala Model*:

$$\text{Adjusted WES-TWA} = \frac{8 \times (24-h) \times \text{WES-TWA}}{16 \times h}$$

where h = hours worked per day

Example 3

Substance: Isopropyl alcohol

WES-TWA: 400ppm

WES-STEL 500ppm

Workshift: 12 hours

$$\text{Adjusted WES-TWA} = \frac{8 \times (24 - 12) \times \text{WES-TWA}}{16 \times 12}$$

$$= \frac{8 \times 12 \times 400\text{ppm}}{16 \times 12}$$

= 200ppm (12-hour WES-TWA)

The average exposure over the twelve-hour shift would then be compared with the 12-hour WES-TWA standard of 200ppm.

No adjustment would be required for the WES-STEL.

*** Brief and Scala Model**

Several models have been formulated to ensure that people who work altered workshifts are provided with at least as much protection as those working eight hours a day. These include the Brief and Scala Model, pharmacokinetic models and the model used by the United States Occupational Safety and Health Administration (OSHA). The adjustment process is a complex issue and no single model provides a universal solution. Arguably the most scientifically correct are the pharmacokinetic models that take into account the biological half-life of the individual substances. However they tend to be the least conservative, require detailed information about the substance and involve

complex calculations. The Brief and Scala Model is relatively easy to apply and takes into account both the increased work hours and the decrease in the recovery period between shifts.

It is noted that in some circumstances the Brief and Scala model may be excessively protective. While in these cases the use of other models is not ruled out, they should only be applied when all of the relevant data is available. In particular if a pharmacokinetic model is to be used, then an understanding of the toxicology and pharmacokinetics of the substance is required. The adjustment of exposure limits is discussed in detail in Patty's Industrial Hygiene and Toxicology[2]

4. Units of Measurement

The concentration of a substance in air is usually expressed in the terms parts per million (ppm) by volume, or gravimetrically as milligrams per cubic metre of air (mg/m^3).

One advantage of expressing concentrations in ppm is that temperature and pressure are taken into account, allowing a standard to be equally applicable over a range of ambient conditions. Standards for substances that normally exist in air as a gas or vapour are usually initially established in terms of ppm. The unit mg/m^3 is temperature- and pressure-dependent but it is applicable to gases, vapours, dusts and fumes.

The workplace exposure standards for gases and vapours are expressed in ppm, with the derived units mg/m^3 also being listed. In the case of particulates, the concentration is given in mg/m^3. A temperature of 25°C and a pressure of 760 torr has been used in the conversion from ppm to mg/m^3. The conversion equation is:

$$\text{WES in } mg/m^3 = \frac{\text{WES (in ppm) x gram molecular weight of the substance}}{24.45}$$

To avoid significant differences between the two sets, the derived mg/m^3 values have been rounded to two or three significant figures — no increase in the precision of the standard is implied.

5. Mixed Exposures

Generally, the exposure standards are listed for a single substance or a range of compounds with a common toxic entity (e.g. compounds of arsenic). In some instances, for practical reasons, a standard has been set for a group of substances (e.g. petrol fumes). Often a worker will be exposed to several vapours, dusts, or aerosols over the working day. Before an assessment of the existing hazard can be made, it is important to have determined the airborne concentration of each substance.

In some instances it may be possible to measure the concentration of a "marker" and use the known composition of the bulk material to estimate the remaining levels. This should only be attempted when there is good reason to believe the proportions in the workplace air will mirror those in the original substance. It would not be valid, for example, to assume that the composition of vapour coming from a material containing a mixture of solvents of different volatilities can be anticipated from the solvent concentrations in the bulk material.

INDEPENDENT EFFECTS

If there is evidence to suggest that the actions of the substances on the body are independent, the concentrations of the individual substances should be compared directly with their appropriate standards. This is most obvious when there are two different target organs. For example, the exposure limit for benzene is determined by its action on the bone marrow, therefore its effects could not be considered to be additive with those of other aromatic hydrocarbons.

ADDITIVE EFFECTS

Although it is simplistic, a pragmatic approach is to consider the effects of substances with similar toxicologic action to be additive. This may be applied, for example, to a mixture of organic solvents having like narcotic action.

If the combined WES is not to be exceeded then:

$$\frac{C_1}{WES_1} + \frac{C_2}{WES_2} + \frac{C_3}{WES_3} + \ldots \frac{C_n}{WES_n}$$ should be less than 1

An example is given in appendix 2.

GREATER THAN ADDITIVE EFFECTS

The combined action may be greater than that predicted from the sum of the individual responses (synergistic effect), or a substance that is not itself toxic may potentiate or enhance the effect of a toxic chemical. The fact that the present understanding of synergistic effects is far from complete emphasises the need for a prudent approach to mixed exposures. It is important that the assessment of all exposures should be made in consultation with suitably qualified and experienced persons, and this is especially so in the case of mixed exposures.

6. Aerosols

Airborne particulates, or aerosols, encountered in the workplace include dusts, fumes, and mists.

Dusts are discrete particles suspended in air, originating from the attrition of solids (primary dusts) or the stirring up of powders or other finely divided materials (secondary dusts). Dusts encountered in the workplace typically contain particles covering a wide range of sizes.

Fumes are airborne particulates with diameters generally less than 1 μm. They may be formed by both thermal mechanisms (e.g. condensation of volatilised solids, or incomplete combustion) and chemical processes (e.g. vapour phase reactions). Agglomeration of fume particles may occur, resulting in the formation of much larger particles.

Mists are droplets of liquid suspended in air. They may be formed by the condensation of a vapour, or mechanical actions such as the atomisation of liquids in spray systems.

The parameter influencing the behaviour of particles in air is the equivalent aerodynamic diameter. The aerodynamic diameter of a particle of any shape and density is defined as the diameter of a sphere with a density of 1.0 g/cm^3 which has the same terminal velocity of settling in still or laminarly flowing air as the particle in question.

Airborne particulates are associated with biological effects that can be classified as: infectious, carcinogenic, fibrogenic, systemic, allergenic, or irritative. The target organ may be within the respiratory system or, if the effect is systemic, elsewhere in the body. The concentration of the substance in air, either in terms of weight or number of particles per unit volume, is not the only factor related to the toxic potential. Particle size distribution also plays an important role as it determines the fraction of the inhaled mass that is deposited at the different sites within the respiratory system.

Three mechanisms are responsible for the deposition of particles within the airways: inertial impaction, sedimentation and diffusion.

Impaction is most effective for particles larger than 5 μm. The majority of particles in this size range are unable to negotiate passages in the nose and pharynx.

Sedimentation, the settling of particles under their own weight, is important in the small airways for particles of 1 to 5 μm.

Diffusion, or Brownian movement, results from collisions with gas molecules, and only becomes significant for particles less than approximately 0.5

μm. Diffusion is most effective in the alveoli and small airways where the distances between the walls are small.

Not all particles present in the workplace air will be taken in through the nose or mouth. Other particles are inhaled and not deposited but exhaled in the next breath. Particles in the order of 0.5 - 1.0 μm are not effectively removed by impaction, sedimentation or diffusion, and tend to be under-represented in the material deposited. Aerosols in this size range are not necessarily toxicologically insignificant, however, as the forces that influence their low efficiency of collection in the respiratory system also act against their removal from the workplace air.

The efficiency of deposition may also be influenced by other characteristics of the particles. Hygroscopic particles (e.g. sulphuric acid mist) will increase in size as they absorb water and the effective diameter may be greater than the observed. Fibres have a tendency to become aligned in the airflow and are therefore able to penetrate further into the respiratory system than would be anticipated from consideration of their mass.

Although it is possible to define mass fractions relating to various sites in the respiratory system, it is the inspirable and respirable fractions that are more commonly determined.

Inspirable dust is the portion of airborne dust that is taken in through the mouth and nose during breathing.

Respirable dust corresponds to the fraction of total inspirable dust that is able to penetrate and deposit in the lower bronchioles and alveolar region.

Inspirable and respirable dust fractions are defined and the collection techniques specified in Appendix1. Unless otherwise stated, the Workplace Exposure Standards for dust refer to inspirable dust. **Workplace Exposure Standards of 10mg/m^3 for the inspirable fraction and 3mg/m^3 for the respirable fraction apply to insoluble particulate where there is no indication that a more stringent standard should apply.** If there is doubt about the contribution that a toxic impurity in the dust may have to the overall hazard, then additionally the levels of this impurity in air should be compared directly against the appropriate standard. For example, if the dust contains asbestos, then a specific determination for asbestos in air should be carried out.

7. Carcinogens

For cancers induced by exposure to chemicals, the time between the initial exposure and the diagnosis of disease is typically several years. This latency period may vary with the particular substance, the intensity and length of exposure, and the individual.

Evidence for the carcinogenicity of substances encountered in the workplace is obtained from both epidemiological and animal studies. Practical limitations, including the difficulty in obtaining reliable estimations on the nature and degree of exposure in epidemiological studies, and the long latency period of occupational cancers, have inhibited the classification of carcinogens.

The existence of exposure thresholds, defining no-effect levels, has been postulated but this cannot be confirmed from the evidence provided by epidemiology or animal studies.

Substances which have been identified as confirmed or possible human carcinogens are noted in the main list of Workplace Exposure Standards. In general the recommendations made by the ACGIH[4] for classifying workplace carcinogens have been adopted. When interpreting the risk posed by individual substances the documentation that supports the Workplace Exposure Standards should be consulted[4,5,6]. Three categories of carcinogens are noted.

A1 Carcinogen - *Confirmed Human Carcinogen.* The substance is carcinogenic to humans based on the weight of evidence from epidemiological studies.

A2 Carcinogen – *Suspected Human Carcinogen*. Human data are accepted as adequate in quality, but are conflicting or insufficient to classify the substance as a confirmed human carcinogen; or the substance is carcinogenic in experimental animals at dose(s), by route(s) of exposure, at site(s), of histological type(s), or by mechanism(s) considered relevant to worker exposure. The A2 carcinogen rating is used primarily when there is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals with relevance to humans.

A3 Carcinogen – *Confirmed Animal Carcinogen with Unknown Relevance to Humans:* The substance is carcinogenic in experimental animals at a relatively high dose, by route(s) of administration, at site(s), of histological type(s), or by mechanism(s) that may not be relevant to worker exposure. Available epidemiological studies do not confirm an increased risk of cancer in exposed humans. Available evidence does not suggest that the agent is likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.

Wherever technically feasible substances that have been identified as confirmed or possible workplace carcinogens should be replaced by less hazardous

substances. If this is not feasible the hierarchy of control specified in the Approved *Code of Practice for the Management of Substances Hazardous to Health*[1] must be strictly applied. Where appropriate air monitoring or biological monitoring should be employed to demonstrate that exposure is being kept to the lowest practicable level. All workers likely to be exposed to carcinogens must receive information about the hazard they face and training in minimising exposure to those substances.

8. Skin Absorption

Some substances are able to penetrate the intact skin and this may result in a higher uptake than would have been expected from inhalation only. Uptake through the skin is not usually the most significant route of absorption but there are exceptions. For example, skin contact with organophosphate pesticides is thought to account for the majority of uptake experienced when working with the products. There is also evidence that absorption of vapour through the skin may be significant for some substances.

As the workplace exposure standard only takes into consideration the inhalation component, care should be taken when interpreting air sampling results where there is a possibility of significant uptake through the skin. Respiratory protection may give a false sense of security. This is particularly pertinent where vapour phase skin absorption occurs, as in this case there may be no obvious contact between the skin and the substance. Biological monitoring for exposure may be a useful adjunct to air sampling in these situations.

Substances that are considered to have potential for skin absorption are identified in the list of Workplace Exposure Standards with a “skin” notation.

9. Work Load

An increase in work load can influence the uptake of a substance by increasing the lung ventilation rate and blood flow. For gases and vapours the extent of this increase is dependent on, among other factors, the solubility of the substance in blood. If the substance is very soluble in blood, the uptake is related directly to the respiratory volume. If the substance is only slightly soluble in blood, the circulation rate becomes the determining factor and respiratory volume does not have a significant influence. Exposure standards have generally been derived assuming a moderate work load. It is a factor that should be considered, especially where both the workload and exposure are high. The following table gives lung ventilation rates at different work loads:

Assessment of Work Load	*Lung Ventilation litres/min*
Very low (resting)	6-7
Low	11-20
Moderate	20-31
High	31-43
Very high	43-56

10. Sensitisers

Exposure to some substances can lead to the development of an allergic sensitisation, usually affecting the skin or respiratory system. High exposures may hasten the onset of the allergy, but once developed in an individual, very low exposures may provoke a reaction. Even although low exposure standards have been specified for known sensitisers, the levels do not necessarily provide adequate protection for sensitised persons. Avoiding further exposure may be the only option for these individuals.

A number of substances, including formaldehyde and acid anhydrides, are known to be both respiratory and skin sensitisers while in other instances the effect is more commonly associated with a particular site. For example, toluene diisocyanate (TDI) is a recognised respiratory sensitiser but it has also been associated with skin effects; chromic acid responses are commonly associated with the skin.

11. Simple Asphyxiants

Some gases and vapours, when they are present in the air in significant concentrations, behave as asphyxiants by reducing the concentration of oxygen by dilution. The oxygen content of air should be maintained at or above 19.5% by volume under normal atmospheric pressure.

Atmospheres that are deficient in oxygen do not provide adequate sensory warning of danger and most simple asphyxiants are odourless.

Simple asphyxiants can also present an explosion hazard.

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Acetaldehyde (2001, A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[75-07-0]	20	-	50	-
Acetamide See Appendix 6 for exposure limits set by other organisations	[60-35-5]	-	-	-	-
Acetic acid	[64-19-7]	10	25	15	37
Acetic anhydride	[108-24-7]	Ceiling 5ppm (21 mg/m3)			
Acetone (bio) See Appendix 6 for exposure limits set by other organisations	[67-64-1]	500	1,185	1,000	2,375
Acetone cyanohydrin See Appendix 6 for exposure limits set by other organisations	[75-86-5]	-	-	-	-
Acetonitrile (skin) See Appendix 6 for exposure limits set by other organisations	[75-05-8]	40	67	60	101
Acetophenone See Appendix 6 for exposure limits set by other organisations	[98-86-2]	-	-	-	-
Acetylene	[74-86-2]	Simple asphyxiant-may present an explosion hazard.			
Acetylene dichloride (see 1,2-Dichloroethylene)					
Acetylene tetrabromide See Appendix 6 for exposure limits set by other organisations	[79-27-6]	1	14	-	-
Acetylsalicylic acid	[50-78-2]	-	5	-	-
Acrolein See Appendix 6 for exposure limits set by other organisations	[107-02-8]	0.1	0.23	-	-
Acrylamide (skin, A3 CARCINOGEN)	[79-06-1]	-	0.03	-	-
Acrylic acid (skin)	[79-10-7]	2	5.9	-	-
Acrylic acid polymer See Appendix 6 for exposure limits set by other organisations	[903-04-7]	-	-	-	-
Acrylonitrile (skin, A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[107-13-1]	2	4.3	-	-
Adipic acid See Appendix 6 for exposure limits set by other organisations	[124-04-9]	-	-	-	-
Adiponitrile See Appendix 6 for exposure limits set by other organisations	[111-69-3]	-	-	-	-
Aflatoxins See Appendix 6 for exposure limits set by other organisations		-	-	-	-
Aldrin (skin, A3 CARCINOGEN)	[309-00-2]	-	0.25	-	-
Allyl alcohol See Appendix 6 for exposure limits set by other organisations	[107-18-6]	2	4.8	4	9.5
Allyl chloride (A3 CARCINOGEN)	[107-05-1]	1	3.0	2	6.0
Allyl glycidyl ether (AGE) See Appendix 6 for exposure limits set by other organisations	[106-92-3]	5	23	10	47
Allyl propyl disulfide	[2179-59-1]	2	12	3	18

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
α Alumina (see Aluminium oxide)					
Aluminium, as Al	[7429-90-5]				
Metal dust		-	10	-	-
Pyro powders		-	5	-	-
Welding fumes		-	5	-	-
Soluble salts		-	2	-	-
Alkyls (Not otherwise classified)		-	2	-	-
Aluminium oxide	[1344-28-1]	-	10[d]	-	-
4-Aminodiphenyl (skin, A1 CARCINOGEN)	[92-67-1]	-	-	-	-
2-Aminoethanol (see Ethanolamine)					
2-Aminopyridine	[504-29-0]	0.5	2.0	-	-
3-Amino-1,2,4-triazole (see Amitrole)					
Amitrole (A3 CARCINOGEN)	[61-82-5]	-	0.2	-	-
Ammonia	[7664-41-7]	25	17	35	24
See Appendix 6 for exposure limits set by other organisations					
Ammonium chloride fume	[12125-02-9]	-	10	-	20
Ammonium perfluorooctanoate (skin, A3 CARCINOGEN)	[3825-26-1]	-	0.1	-	-
See Appendix 6 for exposure limits set by other organisations					
Ammonium sulphamate	[7773-06-0]	-	10	-	-
Amosite (see Asbestos)					
n-Amyl acetate	[628-63-7]	100	532	-	-
sec-Amyl acetate	[626-38-0]	125	665	-	-
Aniline & homologues (skin, 2001, A3 CARCINOGEN)	[62-53-3]	1	4	-	-
Anisidine (o-, p- isomers) (skin, A3 CARCINOGEN)	[29191-52-4]	0.1	0.50	-	-
Antimony & compounds, as Sb	[7440-36-0]	-	0.5	-	-
Antimony hydride (see Stibine)					
Antimony trioxide	[1309-64-4]				
Handling & use, as Sb		-	0.5	-	-
Production (A2 CARCINOGEN)		-	-	-	-
ANTU	[86-88-4]	-	0.3	-	-
p-Aramide	[24938-64-5]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Argon	[7440-37-1]	Simple asphyxiant			
Arsenic & soluble compounds, as As	[7440-38-2]	-	0.05	-	-
(A1 CARCINOGEN, bio) See Appendix 6 for exposure limits set by other organisations					
Arsine	[7784-42-1]	0.05	0.16	-	-
See Appendix 6 for exposure limits set by other organisations					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Asbestos (e, A1 CARCINOGEN)	[1332-21-4]				
Chrysotile	[12001-29-5]	(1) An average concentration over any 4-hour period of one fibre per millilitre of air; and (2) An average concentration over any 10-minute period of 6 fibres per millilitre of air.			
Amosite	[12172-73-5]	(1) An average concentration over any 4-hour period of 0.1 fibres per millilitre of air; and			
Crocidolite	[12001-28-4]				
Fibrous actinolite					
Fibrous anthophyllite					
Fibrous tremolite	[77536-68-6]	(2) An average concentration over any 10-minute period of 0.6 fibres per millilitre of air.			
The maximum allowable concentrations of asbestos are established by *Gazette* notice and are liable to alterations.					
See appendix 6 for exposure limits set by other organisations					
Asphalt (petroleum) fumes	[8052-42-4]	-	5	-	-
Aspirin (see Acetylsalicylic acid)					
Atrazine	[1912-24-9]	-	5	-	-
Azinphos-methyl (skin)	[86-50-0]	-	0.2	-	-
Azodicarbonamide (sen)	[123-77-3]	-	-	-	-
Barium, soluble compounds, as Ba	[7440-39-3]	-	0.5	-	-
Barium sulphate	[7727-43-7]	-	10[d]	-	-
See Appendix 6 for exposure limits set by other organisations					
Benomyl	[17804-35-2]	0.84	10	-	-
Benz(a)anthracene (A2 CARCINOGEN)	[56-55-3]	-	-	-	-
Benzene (skin, A1 CARCINOGEN)	[71-43-2]	5	16	-	-
See Appendix 6 for exposure limits set by other organisations					
Benzidine (skin, A1 CARCINOGEN)	[92-87-5]	-	-	-	-
Benzo(b)fluoranthene (A2 CARCINOGEN)	[205-99-2]	-	-	-	-
p-Benzoquinone (see Quinone)					
Benzoyl peroxide	[94-36-0]	-	5	-	-
Benzo(a)pyrene (A2 CARCINOGEN)	[50-32-8]	-	-	-	-
Benzotrichloride (skin, A3 CARCINOGEN)	[98-07-7]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Benzoyl chloride	[98-88-4]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Benzyl Acetate	[140-11-4]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Benzyl butyl phthalate (2001)	[85-68-7]	-	5	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Benzyl chloride (A3 CARCINOGEN)	[100-44-7]	1	5.2	-	-
Beryllium & compounds, as Be (A1 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[7440-41-7]	-	0.002	-	-
Biphenyl	[92-52-4]	0.2	1.3	-	-
Bis[2-dimethylaminoethyl]ether (DMAEE) See Appendix 6 for exposure limits set by other organisations	[3033-62-3]	-	-	-	-
Bismuth telluride	[1304-82-1]	-	10		
Se-doped		-	5	-	-
Borates, tetra, sodium salts	[1303-96-4]				
Anhydrous		-	1	-	-
Decahydrate		-	5	-	-
Pentahydrate		-	1	-	-
Boron oxide	[1303-86-2]	-	10	-	-
Boron tribromide	[10294-33-4]	Ceiling 1 ppm (10 mg/m3)			
Boron trifluoride	[7637-07-2]	Ceiling 1 ppm (2.8 mg/m3)			
Bromacil (A3 CARCINOGEN)	[314-40-9]	1	11	-	-
Bromine (2001)	[7726-95-6]	0.1	0.66	0.3	2
Bromine pentafluoride	[7789-30-2]	0.1	0.72	-	-
Bromochloromethane (see Chlorobromomethane)					
Bromoform (skin, A3 CARCINOGEN)	[75-25-2]	0.5	5.2	-	-
1,3-Butadiene (A2 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[106-99-0]	10	22	-	-
Butane	[106-97-8]	800	1,900	-	-
Butanethiol (see Butyl mercaptan)					
2-Butanone (see Methyl ethyl ketone)					
2-Butoxyethanol (skin) See Appendix 6 for exposure limits set by other organisations	[111-76-2]	25	121	-	-
2-Butoxyethyl acetate See Appendix 6 for exposure limits set by other organisations	[112-07-2]	-	-	-	-
n-Butyl acetate	[123-86-4]	150	713	200	950
sec-Butyl acetate	[105-46-4]	200	950	-	-
tert-Butyl acetate See Appendix 6 for exposure limits set by other organisations	[540-88-5]	200	950	-	-
Butyl acrylate (sen) See Appendix 6 for exposure limits set by other organisations	[141-32-2]	10	52	-	-
n-Butyl alcohol (skin)	[71-36-3]	Ceiling 50 ppm (150 mg/m3)			
sec-Butyl alcohol	[78-92-2]	100	303	-	-
tert-Butyl alcohol See Appendix 6 for exposure limits set by other organisations	[75-65-0]	100	303	150	455

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
sec-Butylamine See Appendix 6 for exposure limits set by other organisations	[13952-84-6]		-	-	-
tert-Butylamine See Appendix 6 for exposure limits set by other organisations	[75-64-9]		-	-	-
Butylated hydroxytoluene (see 2,6-Di-tert-butyl-p-cresol)					
tert-Butyl chromate, as CrO_3 (skin)	[1189-85-1]	Ceiling 0.1 mg/m3			
n-Butyl glycidyl ether (BGE) (sen) See Appendix 6 for exposure limits set by other organisations	[2426-08-6]	25	133	-	-
n-Butyl lactate	[138-22-7]	5	30	-	-
Butyl mercaptan	[109-79-5]	0.5	1.8	-	-
o-sec-Butylphenol (skin)	[89-72-5]	5	31	-	-
p-tert-Butyltoluene See Appendix 6 for exposure limits set by other organisations	[98-51-1]	10	61	20	121
n-Butyronitrile See Appendix 6 for exposure limits set by other organisations	[109-74-0]	-	-	-	-
Cadmium & compounds, as Cd (A2 CARCINOGEN, bio)	[7440-43-9]	- -	0.01 Inspirable dust 0.002 Respirable dust		
Caesium hydroxide	[21351-79-1]	-	2	-	-
Calcium carbonate	[1317-65-3]	-	10[d]	-	-
Calcium chromate, as Cr (A2 CARCINOGEN)	[13765-19-0]	-	0.001	-	-
Calcium cyanamide	[156-62-7]	-	0.5	-	-
Calcium hydroxide	[1305-62-0]	-	5	-	-
Calcium oxide	[1305-78-8]	-	2	-	-
Calcium silicate	[1344-95-2]	-	10[d]	-	-
Calcium sulphate	[7778-18-9]	-	10[d]	-	-
Camphor, synthetic	[76-22-2]	2	12	3	19
Caprolactam dust Vapour	[105-60-2]	- 5	1 23	- 10	3 46
Captafol (skin)	[2425-06-1]	-	0.1	-	-
Captan (A3 CARCINOGEN)	[133-06-2]	-	5	-	-
Carbaryl	[63-25-2]	-	5	-	-
Carbofuran	[1563-66-2]	-	0.1	-	-
Carbon black	[1333-86-4]	-	3	-	-
Carbon dioxide	[124-38-9]	5,000	9,000	30,000	54,000
Carbon disulphide (skin) See Appendix 6 for exposure limits set by other organisations	[75-15-0]	10	31	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Carbon monoxide (bio) See Appendix 5	[630-08-0]	-		200 ppm 15 min 100 ppm 30 min 50 ppm 60 min	
Carbon tetrabromide	[558-13-4]	0.1	1.4	-	-
Carbon tetrachloride (skin, A2 CARCINOGEN, 2001)	[56-23-5]	0.1	0.63	-	-
Carbonyl chloride (see Phosgene)					
Carbonyl fluoride	[353-50-4]	2	5.4	5	13
Catechol (skin, A3 CARCINOGEN)	[120-80-9]	5	23	-	-
Cellulose (paper fibre)	[9004-34-6]	-	10[d]	-	-
Cement (see Portland cement)					
Cetylmercaptan See Appendix 6 for exposure limits set by other organisations	[2917-26-2]	-	-	-	-
Chlordane (skin, A3 CARCINOGEN)	[57-74-9]	-	0.5	-	-
Chlordecone See Appendix 6 for exposure limits set by other organisations	[143-50-0]	-	-	-	-
Chlorinated camphene (skin,A3 CARCINOGEN)	[8001-35-2]	-	0.5	-	1
Chlorinated diphenyl oxide	[55720-99-5]	-	0.5	-	-
Chlorine	[7782-50-5]	0.5	1.5	1	2.9
Chlorine dioxide	[10049-04-4]	0.1	0.28	-	-
Chlorine trifluoride	[7790-91-2]	Ceiling 0.1 ppm (0.38 mg/m^3)			
Chloroacetaldehyde	[107-20-0]	Ceiling 1 ppm (3.2 mg/m^3)			
Chloroacetone (skin)	[78-95-5]	Ceiling 1 ppm (3.8 mg/m^3)			
α-Chloroacetophenone	[532-27-4]	0.05	0.32	-	-
Chloroacetyl chloride (skin)	[79-04-9]	0.05	0.23	0.15	0.69
Chlorobenzene (A3 CARCINOGEN)	[108-90-7]	10	46	-	-
o-Chlorobenzylidene malononitrile (skin)	[2698-41-1]	Ceiling 0.05 ppm (0.39 mg/m^3)			
Chlorobromomethane	[74-97-5]	200	1,060	-	-
2-Chloro-1,3-butadiene (see β-Chloroprene)					
1-Chloro-1,1-difluoroethane See Appendix 6 for exposure limits set by other organisations	[75-68-3]	-	-	-	-
Chlorodifluoromethane See Appendix 6 for exposure limits set by other organisations	[75-45-6]	1,000	3,540	-	-
Chlorodiphenyl (see Polychlorinated biphenyls)					
1-Chloro-2,3-epoxy propane (see Epichlorohydrin)					
2-Chloroethanol (see Ethylene chlorohydrin)					
Chloroethylene (see Vinyl chloride)					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Chloroform (skin, A3 CARCINOGEN, 2001)	[67-66-3]	2	9.9	-	-
See Appendix 6 for exposure limits set by other organisations					
bis(Chloromethyl) ether (A1 CARCINOGEN)	[542-88-1]	0.001	0.0047	-	-
Chloromethyl methyl ether (A2 CARCINOGEN)	[107-30-2]	-	-	-	-
1-Chloro-1-nitropropane	[600-25-9]	2	10	-	-
Chloropentafluoroethane	[76-15-3]	1,000	6,320	-	-
Chloropicrin	[76-06-2]	0.1	0.67	-	-
β-Chloroprene (skin)	[126-99-8]	10	36	-	-
See Appendix 6 for exposure limits set by other organisations					
2-Chloropropionic acid (skin)	[598-78-7]	0.1	0.44	-	-
o-Chlorostyrene	[2039-87-4]	50	283	75	425
Chlorosulphonic acid (2001)	[7790 94-5]	-	1	-	-
o-Chlorotoluene	[95-49-8]	50	259	-	-
Chlorotrifluoromethane	[75-72-9]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
2-Chloro-6-(trichloromethyl) pyridine (see Nitrapyrin)					
Chlorpyrifos (skin)	[2921-88-2]	-	0.2	-	-
Chromite ore processing (Chromate), as Cr (A1 CARCINOGEN)			0.05	-	-
Chromium metal	[7440-47-3]	-	0.5	-	-
Chromium (II) compounds, as Cr		-	0.5	-	-
Chromium (III) compounds, as Cr		-	0.5	-	-
Chromium (VI) compounds, as Cr (bio)					
Water soluble (sen)		-	0.05	-	-
Certain water insoluble (sen, A1 CARCINOGEN)		-	0.05	-	-
See Appendix 6 for exposure limits set by other organisations					
Chromyl chloride	[14977-61-8]	0.025	0.16	-	-
Chrysene (A3 CARCINOGEN)	[218-01-9]	-	-	-	-
Chrysotile (see Asbestos)					
Clopidol	[2971-90-6]	-	10	-	-
Coal dust		-	3mg/m3 Respirable dust		
		-	0.15mg/m3 Respirable quartz		
See Appendix 6 for exposure limits set by other organisations					
Coal tar pitch volatiles, as benzene solubles (A1 CARCINOGEN)	[65996-93-2]	-	0.2	-	-
See Appendix 6 for exposure limits set by other organisations					
Cobalt metal dust & fume, as Co (A3 CARCINOGEN,bio)	[7440-48-4]	-	0.05	-	-
See Appendix 6 for exposure limits set by other organisations					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Cobalt carbonyl, as Co (sen)	[10210-68-1]	-	0.1	-	-
Cobalt hydrocarbonyl, as Co (sen)	[16842-03-8]	-	0.1	-	-
Copper fume	[7440-50-8]	-	0.2	-	-
Dusts & mists, as Cu		-	1	-	-
See Appendix 6 for exposure limits set by other organisations					
Cotton dust, raw		-	0.2[f]	-	-
Cresol, all isomers (skin)	[1319-77-3]	5	22	-	-
Cristobalite (see Silica-Crystalline)					
Crocidolite (see Asbestos)					
Crotonaldehyde (skin, A3 CARCINOGEN)	[4170-30-3]	2	5.7	-	-
See Appendix 6 for exposure limits set by other organisations					
Crufomate	[299-86-5]	-	5	-	-
Cumene (skin, 2001)	[98-82-8]	25	125	75	375
Cyanamide	[420-04-2]	-	2	-	-
Cyanides, as CN (skin)	[151-50-8; 143-33-9]	-	5	-	-
Cyanogen	[460-19-5]	10	21	-	-
Cyanogen chloride	[506-77-4]	Ceiling 0.3 ppm (0.75 mg/m3)			
See Appendix 6 for exposure limits set by other organisations					
Cyclohexane (2001)	[110-82-7]	100	350	300	1050
Cyclohexanol (skin)	[108-93-0]	50	206	-	-
Cyclohexanone (skin)	[108-94-1]	25	100	-	-
Cyclohexene	[110-83-8]	300	1,010	-	-
Cyclohexylamine	[108-91-8]	10	41	-	-
Cyclohexylmercaptan	[1569-69-3]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Cyclonite (skin)	[121-82-4]	-	1.5	-	-
See Appendix 6 for exposure limits set by other organisations					
Cyclopentadiene	[542-92-7]	75	203	-	-
Cyclopentane	[287-92-3]	600	1,720	-	-
Cyhexatin	[13121-70-5]	-	5	-	-
2,4-D	[94-75-7]	-	10	-	-
See Appendix 6 for exposure limits set by other organisations					
DDT (see Dichlorodiphenyltrichloroethane)					
Decaborane (skin)	[17702-41-9]	0.05	0.25	-	-
Decylmercaptan	[143-10-2]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Demeton (skin)	[8065-48-3]	0.01	0.11	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Diacetone alcohol	[123-42-2]	50	238	-	-
Dialkyl 79 phthalate (2001)		-	5	-	-
Diallyl phthalate (2001)	[131-17-9]	-	5	-	-
1,2-Diaminoethane (see Ethylenediamine)					
Diatomaceous earth (see Silica-Amorphous)					
Diazinon (skin)	[333-41-5]	-	0.1	-	-
Diazomethane (A2 CARCINOGEN)	[334-88-3]	0.2	0.34	-	-
Diborane	[19287-45-7]	0.1	0.11	-	-
1,2-Dibromo-3-chloropropane (DBCP)	[96-12-8]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
1,2-Dibromoethane (see Ethylene dibromide)					
2-N-Dibutylaminoethanol (skin)	[102-81-8]	2	14	-	-
See Appendix 6 for exposure limits set by other organisations					
Dibutyl phenyl phosphate (skin)	[2528-36-1]	0.3	3.5	-	-
Dibutyl phosphate	[107-66-4]	1	8.6	2	17
Dibutyl phthalate	[84-74-2]	-	5	-	-
Dichloroacetylene (A3 CARCINOGEN)	[7572-29-4]	Ceiling 0.1 ppm (0.39 mg/m3)			
o-Dichlorobenzene (skin)	[95-50-1]	Ceiling 50 ppm (301 mg/m3)			
p-Dichlorobenzene (2001, A3 CARCINOGEN)	[106-46-7]	25	153	50	306
See Appendix 6 for exposure limits set by other organisations					
3,3-Dichlorobenzidine (skin, A3 CARCINOGEN)	[91-94-1]	-	-	-	-
1,4-Dichloro-2-butene (skin, A2 CARCINOGEN)	[764-41-0]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Dichlorodiphenyltrichloroethane (A3 CARCINOGEN)	[50-29-3]	-	1	-	-
Dichlorodifluoromethane	[75-71-8]	1,000	4,950	-	-
1,3-Dichloro-5,5-dimethyl hydantoin	[118-52-5]	-	0.2	-	0.4
1,1-Dichloroethane	[75-34-3]	200	810	250	1,010
See Appendix 6 for exposure limits set by other organisations					
1,2-Dichloroethane (see Ethylene dichloride)					
1,1-Dichloroethylene (see Vinylidene chloride)					
1,2-Dichloroethylene	[540-59-0]	200	793	-	-
Dichloroethyl ether (skin)	[111-44-4]	5	29	10	58
Dichlorofluoromethane	[75-43-4]	10	42	-	-
Dichloromethane (see Methylene chloride)					
1,1-Dichloro-1-nitroethane	[594-72-9]	2	12	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
1,2-Dichloropropane (see Propylene dichloride)					
Dichloropropene (skin)	[542-75-6]	1	4.5	-	-
2,2-Dichloropropionic acid	[75-99-0]	1	5.8	-	-
Dichlorotetrafluoroethane	[76-14-2]	1,000	6,990	-	-
Dichlorvos (skin)	[62-73-7]	0.1	0.90	-	-
Dicrotophos (skin)	[141-66-2]	-	0.25	-	-
Dicyclohexyl phthalate (2001)	[84-61-7]		5	-	-
Dicyclopentadiene See Appendix 6 for exposure limits set by other organisations	[77-73-6]	5	27	-	-
Dicyclopentadienyl iron	[102-54-5]	-	10	-	-
Dieldrin (skin)	[60-57-1]	-	0.25	-	-
Diethanolamine (skin) See Appendix 6 for exposure limits set by other organisations	[111-42-2]	3	13	-	-
Diethylamine (skin) See Appendix 6 for exposure limits set by other organisations	[109-89-7]	10	30	25	75
2-Diethylaminoethanol (skin) See Appendix 6 for exposure limits set by other organisations	[100-37-8]	10	48	-	-
Diethylene glycol (2001) See Appendix 6 for exposure limits set by other organisations	[111-46-6]	23	101	-	-
Diethylene glycol dimethyl ether See Appendix 6 for exposure limits set by other organisations	[111-96-6]	-	-	-	-
Diethylene glycol monobutyl ether See Appendix 6 for exposure limits set by other organisations	[112-34-5]	-	-	-	-
Diethylene glycol monobutyl ether acetate See Appendix 6 for exposure limits set by other organisations	[124-17-4]	-	-	-	-
Diethylene glycol monomethyl ether See Appendix 6 for exposure limits set by other organisations	[1675-54-3]	-	-	-	-
Diethylene triamine (skin)	[111-40-0]	1	4.2	-	-
Diethyl ether (see Ethyl ether)					
Di(2-ethylhexyl)phthalate (see Di-sec-octyl phthalate)					
Diethyl ketone	[96-22-0]	200	705	-	-
Diethyl phthalate	[84-66-2]	-	5	-	-
Diethyl sulphate (skin, 2001)	[64-67-5]	0.05	0.32	-	-
Difluorodibromomethane	[75-61-6]	100	858	-	-
Diglycidyl ether (DGE)	[2238-07-5]	0.1	0.53	-	-
Dihydroxybenzene (see Hydroquinone)					
Diisobutyl ketone	[108-83-8]	25	145	-	-
Diisobutyl phthalate (2001)	[84-69-5]	-	5	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Diisodecyl phthalate (2001)	[26761-40-0]	-	5	-	-
Diisononyl phthalate (2001)	[28553-12-0]	-	5	-	-
Diisooctyl phthalate (2001)	[27554-26-3]	-	5	-	-
Diisopropylamine (skin)	[108-18-9]	5	21	-	-
Di-linear 79 phthalate (2001)		-	5	-	-
Dimethoxymethane (see Methylal)					
Dimethyl acetamide (skin)	[127-19-5]	10	36	-	-
Dimethylamine See Appendix 6 for exposure limits set by other organisations	[124-40-3]	10	18	-	-
Dimethylaminoethanol (2001)	[108-01-0]	2	7.4	6	22
Dimethylaminobenzene (see Xylidene)					
N,N-Dimethylaniline (skin)	[121-69-7]	5	25	10	50
Dimethylbenzene (see Xylene)					
Dimethyl carbamoyl chloride (A2 CARCINOGEN)	[79-44-7]	-	-	-	-
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate (see Naled)					
Dimethylether (2001)	[115-10-6]	400	766	500	958
Dimethylethoxysilane See Appendix 6 for exposure limits set by other organisations	[14857-34-2]	-	-	-	-
N,N-Dimethylethylamine (2001)	[598-56-1]	10	30	15	46
Dimethylformamide (skin)	[68-12-2]	10	30	-	-
2,6-Dimethyl-4-heptanone (see Diisobutyl ketone)					
1,1-Dimethylhydrazine (skin, A3 CARCINOGEN)	[57-14-7]	0.01	0.025	-	-
Dimethylnitrosoamine (see N-Nitrosodimethylamine)					
Dimethylphthalate	[131-11-3]	-	5	-	-
Dimethyl sulphate (skin, A3 CARCINOGEN, 2001)	[77-78-1]	0.05	0.26	-	-
Dimethyl sulphoxide See Appendix 6 for exposure limits set by other organisations	[67-68-5]	-	-	-	-
Dinitolmide	[148-01-6]	-	5	-	-
Dinitrobenzene, all isomers (skin)	[528-29-0; 99-65-0; 100-25-4]	0.15	1.0	-	-
Dinitro-o-cresol (skin)	[534-52-1]	-	0.2	-	-
3,5-Dinitro-o-toluamide (see Dinitolmide)					
Dinitrotoluene (skin, A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[25321-14-6]	-	1.5	-	-
2,4-Dinitrotoluene See Appendix 6 for exposure limits set by other organisations	[121-14-2]	-	-	-	-
3,5-Dinitrotoluene See Appendix 6 for exposure limits set by other organisations	[618-85-9]	-	-	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Dinonyl phthalate (2001)	[84-76-4]	-	5	-	-
Dioxane (skin, A3 CARCINOGEN)	[123-91-1]	25	90	-	-
Dioxathion (skin)	[78-34-2]	-	0.2	-	-
Diphenyl (see Biphenyl)					
Diphenylamine	[122-39-4]	-	10	-	-
Diphenylmethane diisocyanate (see Isocyanates)					
Dipropylene glycol methyl ether (skin)	[34590-94-8]	100	606	150	909
Dipropyl ketone	[123-19-3]	50	233	-	-
Diquat	[2764-72-9]	-	0.5	-	-
Diquat Dibromide	[85-00-7]	-	0.5	-	-
Di-sec-octyl phthalate (A3 CARCINOGEN)	[117-81-7]	-	5	-	10
Disulfiram	[97-77-8]	-	2	-	-
Disulfoton	[298-04-4]	-	0.1	-	-
2,6-Di-tert-butyl-p-cresol	[128-37-0]	-	10	-	-
Diuron	[330-54-1]	-	10	-	-
Divinyl benzene	[1321-74-0]	10	53	-	-
Emery	[112-62-9]	-	10[d]	-	-
Endosulfan (skin)	[115-29-7]	-	0.1	-	-
Endrin (skin)	[72-20-8]	-	0.1	-	-
Enflurane (2001)	[13838-16-9]	0.5	-	-	-
Enzymes (see Subtilisins)					
Epichlorohydrin (skin, A3 CARCINOGEN, 2001)	[106-89-8]	0.5	1.9	1.5	5.8
EPN (skin)	[2104-64-5]	-	0.5	-	-
See Appendix 6 for exposure limits set by other organisations					
1,2-Epoxypropane (see Propylene oxide)					
2,3-Epoxy-1-propanol (see Glycidol)					
Ethane	[74-84-0]	Simple asphyxiant-may present an explosion hazard			
Ethanethiol (see Ethyl mercaptan)					
Ethanol (see Ethyl alcohol)					
Ethanolamine	[141-43-5]	3	7.5	6	15
Ethion (skin)	[563-12-2]	-	0.4	-	-
2-Ethoxyethanol (skin,bio)	[110-80-5]	5	18	-	-
2-Ethoxyethyl acetate (EGEEA) (skin,bio)	[111-15-9]	5	27	-	-
See Appendix 6 for exposure limits set by other organisations					
Ethyl acetate (2001)	[141-78-6]	200	720	-	-
Ethyl acrylate (sen)	[140-88-5]	Ceiling 5ppm (20mg/m3)			

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m³[c]	STEL ppm[b]	STEL mg/m³[c]
Ethyl alcohol See Appendix 6 for exposure limits set by other organisations	[64-17-5]	1,000	1,880	-	-
Ethylamine (skin) See Appendix 6 for exposure limits set by other organisations	[75-04-7]	10	18	-	-
Ethyl amyl ketone	[541-85-5]	25	131	-	-
Ethyl benzene	[100-41-4]	100	434	125	543
Ethyl bromide (skin, A3 CARCINOGEN)	[74-96-4]	5	22	-	-
Ethyl tert-butyl ether See Appendix 6 for exposure limits set by other organisations	[637-92-3]	-	-	-	-
Ethyl butyl ketone	[106-35-4]	50	234	-	-
Ethyl chloride (skin, A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[75-00-3]	1,000	2,640	-	-
Ethyl chloroformate See Appendix 6 for exposure limits set by other organisations	[541-41-3]	-	-	-	-
Ethyl cyanoacrylate See Appendix 6 for exposure limits set by other organisations	[7085-85-0]	-	-	-	-
Ethylene	[74-85-1]	Simple asphyxiant			
Ethylene chlorohydrin (skin)	[107-07-3]	Ceiling 1 ppm (3.3 mg/m³)			
Ethylenediamine (skin, sen)	[107-15-3]	10	25	-	-
Ethylene dibromide (skin, A3 CARCINOGEN, 2001) See Appendix 6 for exposure limits set by other organisations	[106-93-4]	0.5	3.9	-	-
Ethylene dichloride (skin, 2001) See Appendix 6 for exposure limits set by other organisations	[107-06-2]	5	21	-	-
Ethylene glycol vapour & mist	[107-21-1]	Ceiling 50 ppm (127 mg/m³)			
Ethylene glycol dinitrate (skin)	[628-96-6]	0.05	0.31	-	-
Ethylene glycol isopropylether acetate See Appendix 6 for exposure limits set by other organisations	[19234-20-9]	-	-	-	-
Ethylene glycol methyl ether acetate (see 2-Methoxyethyl acetate)					
Ethylene oxide (A2 CARCINOGEN)	[75-21-8]	1	1.8	-	-
Ethylenimine (skin, A3 CARCINOGEN)	[151-56-4]	0.5	0.88	-	-
Ethyl ether	[60-29-7]	400	1,210	500	1,520
Ethyl formate	[109-94-4]	100	303	-	-
2-Ethylhexyl chloroformate See Appendix 6 for exposure limits set by other organisations	[24468-13-1]	-	-	-	-
Ethylidene chloride (see 1,1-Dichloroethane)					
Ethylidene norbornene	[16219-75-3]	Ceiling 5 ppm (25 mg/m³)			
Ethyl mercaptan	[75-08-1]	0.5	1.3	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Ethyl Methacrylate See Appendix 6 for exposure limits set by other organisations	[97-63-2}	-	-	-	-
N-Ethylmorpholine (skin)	[100-74-3]	5	24	-	-
Ethyl silicate	[78-10-4]	10	85	-	-
Fenamiphos (skin)	[22224-92-6]	-	0.1	-	-
Fensulfothion	[115-90-2]	-	0.1	-	-
Fenthion (skin)	[55-38-9]	-	0.2	-	-
Ferbam	[14484-64-1]	-	10	-	-
Ferrovanadium dust	[12604-58-9]	-	1	-	-
Fibrous glass dust (see Synthetic mineral fibres)					
Flour dust See Appendix 6 for exposure limits set by other organisations		-	-	-	-
Fluorides, as F (bio)		-	2.5	-	-
Fluorine See Appendix 6 for exposure limits set by other organisations	[7782-41-4]	1	1.6	2	3.1
Fluoroxene See Appendix 6 for exposure limits set by other organisations	[406-90-6]	-	-	-	-
Fluorotrichloromethane (see Trichlorofluoromethane)					
Fonofos (skin)	[944-22-9]	-	0.1	-	-
Formaldehyde (sen, A2 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[50-00-0]	Ceiling 1ppm (1.2 mg/m3)			
Formamide (skin)	[75-12-7]	10	18	-	-
Formic acid	[64-18-6]	5	9.4	10	19
Furfural (skin, A3 CARCINOGEN)	[98-01-1]	2	7.9	-	-
Furfuryl alcohol (skin) See Appendix 6 for exposure limits set by other organisations	[98-00-0]	10	40	15	60
Gallium Arsenide See Appendix 6 for exposure limits set by other organisations	[1303-00-0]	-	-	-	-
Gasoline (see Petrol)					
Germanium tetrahydride	[7782-65-2]	0.2	0.63	-	-
Glass, fibrous or dust (see Synthetic mineral fibres)					
Glutaraldehyde (sen, 2001)	[111-30-8]	-	-	0.05	-
Glycerin mist	[56-81-5]	-	10[d]	-	-
Glycidol (A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[556-52-5]	25	76	-	-
Glycidyl methacrylate See Appendix 6 for exposure limits set by other organisations	[106-91-2]	-	-	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Glycol monoethyl ether (see 2-Ethoxyethanol)					
Grain dust (oat, wheat, barley)		-	4	-	-
Graphite, all forms except graphite fibres	[7782-42-5]	-	3Respirable dust containing < 1% free silica		
See Appendix 6 for exposure limits set by other organisations					
Gypsum (see Calcium sulphate)					
Hafnium	[7440-58-6]	-	0.5	-	-
Halothane (2001)	[151-67-7]	0.5	-	-	-
Helium	[7440-59-7]	Simple asphyxiant.			
Heptachlor (skin, A3 CARCINOGEN)	[76-44-8]	-	0.5	-	-
See Appendix 6 for exposure limits set by other organisations					
Heptane (n-Heptane)	[142-82-5]	400	1,640	500	2,050
See Appendix 6 for exposure limits set by other organisations					
2-Heptanone (see Methyl n-amyl ketone)					
3-Heptanone (see Ethyl butyl ketone)					
Hexachlorobenzene (skin, A3 CARCINOGEN)	[118-74-1]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Hexachlorobutadiene (skin, A3 CARCINOGEN)	[87-68-3]	0.02	0.21	-	-
Hexachlorocyclopentadiene	[77-47-4]	0.01	0.11	-	-
Hexachloroethane (skin, A3 CARCINOGEN)	[67-72-1]	1	9.7	-	-
Hexachloronaphthalene (skin)	[1335-87-1]	-	0.2	-	-
Hexafluoroacetone (skin)	[684-16-2]	0.1	0.68	-	-
Hexamethylene diisocyanate (see Isocyanates)					
Hexamethyl phosphoramide (skin, A3 CARCINOGEN)	[680-31-9]	-	-	-	-
Hexane (n-Hexane) (2001, bio)	[110-54-3]	20	72	-	-
Other isomers		500	1,760	1,000	3,500
See Appendix 6 for exposure limits set by other organisations					
2-Hexanone (see Methyl n-butyl ketone)					
Hexone (see Methyl isobutyl ketone)\					
1,6-Hexanediamine	[124-09-4]		-	-	- -
See Appendix 6 for exposure limits set by other organisations					
1-Hexene	[592-41-6]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
sec-Hexyl acetate	[108-84-9]	50	295	-	-
Hexylene glycol	[107-41-5]	Ceiling 25 ppm (121 mg/m3)			
Hydrazine (skin, A3 CARCINOGEN, 2001)	[302-01-2]	0.01	0.013	-	-
Hydrazoic Acid	[7782-79-8]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Hydrogen	[1333-74-0]	Simple asphyxiant - may present an explosion hazard.			
Hydrogenated terphenyls	[61788-32-7]	0.5	4.9	-	-
Hydrogen bromide	[10035-10-6]	Ceiling 3 ppm (9.9 mg/m3)			
Hydrogen chloride	[7647-01-0]	Ceiling 5 ppm (7.5 mg/m3)			
Hydrogen cyanide (skin)	[74-90-8]	Ceiling 10 ppm (11 mg/m3)			
Hydrogen fluoride, as F	[7664-39-3]	Ceiling 3 ppm (2.6 mg/m3)			
Hydrogen peroxide (A3 CARCINOGEN)	[7722-84-1]	1	1.4	-	-
Hydrogen selenide, as Se See Appendix 6 for exposure limits set by other organisations	[7783-07-5]	0.05	0.16	-	-
Hydrogen sulphide	[7783-06-4]	10	14	15	21
Hydroquinone (A3 CARCINOGEN)	[123-31-9]	-	2	-	-
4-Hydroxy-4-methyl-2-pentanone (see Diacetone alcohol)					
2-Hydroxyethyl acrylate See Appendix 6 for exposure limits set by other organisations	[818-61-1]	-	-	-	-
2-Hydroxyethyl methacrylate See Appendix 6 for exposure limits set by other organisations	[868-77-9]	-	-	-	-
2-Hydroxypropyl acrylate (skin)	[999-61-1]	0.5	2.8	-	-
Idomethane (skin, 2001)	[74-88-4]	2	12	-	-
Indene	[95-13-6]	10	48	-	-
Indium & compounds, as In	[7440-74-6]	-	0.1	-	-
Iodine	[7553-56-2]	Ceiling 0.1 ppm (1 mg/m3)			
Iodoform	[75-47-8]	0.6	10	-	-
Iron oxide dust and fume (Fe_2O_3), as Fe	[1309-37-1]	-	5[g]	-	-
Iron pentacarbonyl, as Fe See Appendix 6 for exposure limits set by other organisations	[13463-40-6]	0.1	0.23	0.2	0.45
Iron salts, soluble, as Fe		-	1	-	-
Isoamyl acetate	[123-92-2]	100	532	-	-
Isoamyl alcohol	[123-51-3]	100	361	125	452
Isobutane See Appendix 6 for exposure limits set by other organisations	[75-28-5]	-	-	-	-
Isobutyl acetate See Appendix 6 for exposure limits set by other organisations	[110-19-0]	150	713	-	-
Isobutyl alcohol	[78-83-1]	50	152	-	-
Isobutylamine See Appendix 6 for exposure limits set by other organisations	[78-81-9]	-	-	-	-
Isobutyl methacrylate See Appendix 6 for exposure limits set by other organisations	[97-86-9]	-	-	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Isocyanates, all, (as -NCO) (sen)		-	0.02	-	0.07
		Note: These values apply to all isocyanates, including prepolymers, present in the workplace air as vapours, mist or dust.			
Isooctyl alcohol (skin)	[26952-21-6]	50	266	-	-
Isophorone (A3 CARCINOGEN)	[78-59-1]	Ceiling 5 ppm (28 mg/m3)			
Isophorone diisocyanate (skin) (see Isocyanates)					
Isopropoxyethanol See Appendix 6 for exposure limits set by other organisations	[109-59-1]	25	106	-	-
Isopropyl acetate	[108-21-4]	250	1,040	310	1,290
Isopropyl alcohol See Appendix 6 for exposure limits set by other organisations	[67-63-0]	400	983	500	1,230
Isopropylamine	[75-31-0]	5	12	10	24
N-Isopropylaniline (skin)	[768-52-5]	2	11	-	-
Isopropyl chloroformate See Appendix 6 for exposure limits set by other organisations	[108-23-6]	-	-	-	-
Isopropyl ether	[108-20-3]	250	1,040	310	1,300
Isopropyl glycidyl ether (IGE)	[4016-14-2]	50	238	75	356
Kaolin (2001)	[1332-58-7]	10mg/m3 Inspirable; and 2mg/m3 Respirable dust			
Kerosene See Appendix 6 for exposure limits set by other organisations	[8008-20-6]		-	-	- -
Ketene	[463-51-4]	0.5	0.86	-	-
Lead, inorganic dusts & fumes, as Pb (A3 CARCINOGEN, bio) See Appendix 6 for exposure limits set by other organisations	[7439-92-1]	-	0.1	-	-
Lead arsenate, as $Pb_3(AsO_4)_2$	[10102-48-4]	-	0.15	-	-
Lead chromate, as Cr (A2 CARCINOGEN)	[7758-97-6]	-	0.05	-	-
Limestone (see Calcium carbonate)					
Lindane (skin, A3 CARCINOGEN, 2001)	[58-89-9]	-	0.1	-	-
Lithium hydride	[7580-67-8]	-	0.025	-	-
Lithium hydroxide (2001)	[1310-65-2]	-	-	-	1
LPG (Liquefied petroleum gas)	[68476-85-7]	1,000	1,800	-	-
Magnesite	[546-93-0]	-	10[d]	-	-
Magnesium oxide fume See Appendix 6 for exposure limits set by other organisations	[1309-48-4]	-	10	-	-
Malathion (skin)	[121-75-5]	-	10	-	-
Maleic anhydride (sen) See Appendix 6 for exposure limits set by other organisations	[108-31-6]	0.25	1.0	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Man-made mineral fibres (see Synthetic mineral fibres)					
Manganese dust & compounds, as Mn (2001)	[7439-96-5]	-	1	-	-
Fume, as Mn (2001)	[7439-96-5]	-	1	-	3
See Appendix 6 for exposure limits set by other organisations					
Manganese cyclopentadienyl tricarbonyl, as Mn (skin)	[12079-65-1]	-	0.1	-	-
Marble (see Calcium carbonate)					
MDI (see Isocyanates)					
MEK (see Methyl ethyl ketone)					
Mercury vapour (as Hg) (skin, bio, 2001)	[7439-97-6]	-	0.025	-	-
Inorganic compounds (as Hg)		-	0.025	-	-
alkyl compounds (as Hg)		-	0.01	-	-
Mesityl oxide	[141-79-7]	15	60	25	100
See Appendix 6 for exposure limits set by other organisations					
Methacrylic acid	[79-41-4]	20	70	-	-
Methane	[74-82-8]	Simple asphyxiant - may present an explosion hazard.			
Methanethiol (see Methyl mercaptan)					
Methanol (see Methyl alcohol)					
Methomyl	[16752-77-5]	-	2.5	-	-
Methoxyacetic acid	[625-45-6]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Methoxychlor	[72-43-5]	-	10	-	-
2-Methoxyethanol (skin)	[109-86-4]	5	16	-	-
See Appendix 6 for exposure limits set by other organisations					
2-(2-Methoxyethoxy)ethanol (see Diethylene glycol monomethyl ether)					
2-Methoxyethyl acetate (skin)	[110-49-6]	5	24	-	-
See Appendix 6 for exposure limits set by other organisations					
4-Methoxyphenol	[150-76-5]	-	5	-	-
2-Methoxy-1-propanol	[1589-47-5]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
1-Methoxypropyl-2-acetate	[108-65-6]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
2-Methoxypropyl-1-acetate	[70657-70-4]]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Methyl acetate	[79-20-9]	200	606	250	757
Methyl acetylene	[74-99-7]	1,000	1,640	-	-
Methyl acetylene-propadiene mixture (MAPP)		1,000	1,640	1,250	2,050
Methyl acrylate (skin, sen)	[96-33-3]	10	35	-	-
See Appendix 6 for exposure limits set by other organisations					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m³[c]	STEL ppm[b]	STEL mg/m³[c]
Methylacrylonitrile (skin)	[126-98-7]	1	2.7	-	-
Methylal	[109-87-5]	1,000	3,110	-	-
Methyl alcohol (skin, bio)	[67-56-1]	200	262	250	328
Methylamine See Appendix 6 for exposure limits set by other organisations	[74-89-5]	10	13	-	-
Methyl amyl alcohol (see Methyl isobutyl carbinol)					
Methyl n-amyl ketone	[110-43-0]	50	233	-	-
N-Methyl aniline (skin)	[100-61-8]	0.5	2.2	-	-
Methyl bromide (skin) See Appendix 6 for exposure limits set by other organisations	[74-83-9]	5	19	-	-
Methyl tert-butyl ether (A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[1634-04-4]	-	-	-	-
Methyl n-butyl ketone (skin) See Appendix 6 for exposure limits set by other organisations	[591-78-6]	5	20	-	-
Methyl chloride (skin)	[74-87-3]	50	103	100	207
Methyl chloroacetate See Appendix 6 for exposure limits set by other organisations	[96-34-4]	-	-	-	-
Methyl chloroform	[71-55-6]	125	680	-	-
Methyl 2-cyanoacrylate See Appendix 6 for exposure limits set by other organisations	[137-05-3]	2	9.1	4	18
Methylcyclohexane	[108-87-2]	400	1,610	-	-
Methylcyclohexanol	[25639-42-3]	50	234	-	-
o-Methylcyclohexanone (skin)	[583-60-8]	50	229	75	344
2-Methylcyclopentadienyl manganese tricarbonyl, as Mn (skin)	[12108-13-3]	-	0.2	-	-
Methyl demeton (skin)	[8022-00-2]	-	0.5	-	-
Methylene bisphenyl isocyanate (see Isocyanates)					
Methylene chloride (A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[75-09-2]	50	174	-	-
4,4-Methylene bis(2-chloroaniline) (skin, A2 CARCINOGEN, 2001)	[101-14-4]	-	0.005	-	-
Methylene bis(4-cyclohexylisocyanate) (see Isocyanates)					
4,4-Methylene dianiline (skin, A2 CARCINOGEN, 2001)	[101-77-9]	0.01	0.08	-	-
Methyl ethyl ketone (bio)	[78-93-3]	150	445	300	890
Methyl ethyl ketone peroxide	[1338-23-4]	Ceiling 0.2 ppm (1.5 mg/m³)			
Methyl formate	[107-31-3]	100	246	150	368
5-Methyl-3-heptanone (see Ethyl amyl ketone)					
Methyl hydrazine (skin, A3 CARCINOGEN)	[60-34-4]	Ceiling 0.2 ppm (0.38 mg/m³)			

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Methyl iodide (skin)	[74-88-4]	2	12	-	-
Methyl isoamyl ketone	[110-12-3]	50	234	-	-
Methyl isobutyl carbinol (skin)	[108-11-2]	25	104	40	167
Methyl isobutyl ketone See Appendix 6 for exposure limits set by other organisations	[108-10-1]	50	205	75	307
Methyl isocyanate (skin) See Appendix 6 for exposure limits set by other organisations	[624-83-9]	0.02	0.047	-	-
Methyl isopropyl ketone	[563-80-4]	200	705	-	-
Methyl mercaptan	[74-93-1]	0.5	0.98	-	-
Methyl methacrylate (skin, sen, 2001)	[80-62-6]	50	208	100	416
Methyl parathion (skin)	[298-00-0]	-	0.2	-	-
Methyl propyl ketone	[107-87-9]	200	705	250	881
1-Methyl-2-pyrrolidone (skin, 2001)	[872-50-4]	25	103	75	309
Methyl silicate	[681-84-5]	1	6	-	-
α-Methyl styrene	[98-83-9]	50	242	100	483
Methyl-tert butyl ether (2001)	[1634-04-4]	25	92	75	275
Methyl vinyl ketone See Appendix 6 for exposure limits set by other organisations	[78-94-4]	-	-	-	-
Metribuzin	[21087-64-9]	-	5	-	-
Mevinphos (skin)	[7786-34-7]	0.01	0.092	-	-
Mica See Appendix 6 for exposure limits set by other organisations	[12001-25-2]	-	3mg/m3 Respirable dust		
Mineral wool fibre (see Synthetic mineral fibre)					
MOCA (see 4,4-Methylene bis(2-chloroaniline))					
Molybdenum, as Mo	[7439-98-7]				
Soluble compounds		-	5	-	-
Insoluble compounds		-	10	-	-
Monochloroacetic acid (skin, 2001)	[79-11-8]	0.3	1.2	-	-
Monochlorobenzene (see Chlorobenzene)					
Monocrotophos (skin)	[6923-22-4]	-	0.25	-	-
Morpholine (skin)	[110-91-8]	20	71	-	-
Naled (skin)	[300-76-5]	-	3	-	-
Naphthalene	[91-20-3]	10	52	15	79
β-Naphthylamine (A1 CARCINOGEN)	[91-59-8]	-	-	-	-
Neon	[7440-01-9]	Simple asphyxiant			
Nickel metal (sen)	[7440-02-0]	-	1	-	-
Soluble compounds, as Ni (sen) See Appendix 6 for exposure limits set by other organisations		-	0.1	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m³[c]	STEL ppm[b]	STEL mg/m³[c]
Nickel carbonyl, as Ni See Appendix 6 for exposure limits set by other organisations	[13463-39-3]	0.05	0.12	-	-
Nickel sulphide roasting, fume & dust, as Ni (sen, A1 CARCINOGEN)		-	1	-	-
Nicotine (skin)	[54-11-5]	-	0.5	-	-
Nitrapyrin	[1929-82-4]	-	10	-	20
Nitric acid	[7697-37-2]	2	5.2	4	10
Nitric oxide	[10102-43-9]	25	31	-	-
p-Nitroaniline (skin)	[100-01-6]	-	3	-	-
Nitrobenzene (skin, A3 CARCINOGEN)	[98-95-3]	1	5	-	-
p-Nitrochlorobenzene (skin, A3 CARCINOGEN)	[100-00-5]	0.1	0.64	-	-
4-Nitrodiphenyl (skin, A2 CARCINOGEN)	[92-93-3]	-	-	-	-
Nitroethane	[79-24-3]	100	307	-	-
Nitrogen	[7727-37-9]	Simple asphyxiant			
Nitrogen dioxide See Appendix 6 for exposure limits set by other organisations	[10102-44-0]	3	5.6	5	9.4
Nitrogen trifluoride	[7783-54-2]	10	29	-	-
Nitroglycerin (NG) (skin)	[55-63-0]	0.05	0.46	-	-
Nitromethane (A3 CARCINOGEN, 2001)	[75-52-5]	20	50	-	-
1-Nitropropane	[108-03-2]	25	91	-	-
2-Nitropropane (A2 CARCINOGEN, 2001)	[79-46-9]	5	19	-	-
N-Nitrosodimethylamine (skin, A3 CARCINOGEN)	[62-75-9]	-	-	-	-
Nitrotoluene (skin)	[88-72-2; 99-08-1; 99-99-0]	2	11	-	-
Nitrotrichloromethane (see Chloropicrin)					
Nitrous oxide (2001)	[10024-97-2]	25	45	-	-
Nonane	[111-84-2]	200	1,050	-	-
Nuisance particulates (see Particulates not otherwise classified)					
Octachloronaphthalene (skin)	[2234-13-1]	-	0.1	-	-
Octane See Appendix 6 for exposure limits set by other organisations	[111-65-9]	300	1,400	375	1,750
Oil mist, mineral	[8012-95-1]	-	5[h]	-	10
Osmium tetroxide, as Os	[20816-12-0]	0.0002	0.0016	-	-
Oxalic acid	[144-62-7]	-	1	-	2
Oxygen difluoride	[7783-41-7]	Ceiling 0.05 ppm (0.11 mg/m³)			
Ozone	[10028-15-6]	Ceiling 0.1 ppm (0.20 mg/m³)			
Paraffin wax fume	[8002-74-2]	-	2	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Paraquat	[4685-14-7]	-	0.1	Respirable	
Parathion (skin)	[56-38-2]	-	0.1	-	-
See Appendix 6 for exposure limits set by other agencies					
Particulate polycyclic aromatic hydrocarbons (see Coal tar pitch volatiles)					
Particulates not otherwise classified			10mg/m3 Inspirable dust 3mg/m3 Respirable dust		
PCB (see Polychlorinated biphenyls)					
Pentaborane	[19624-22-7]	0.005	0.013	-	-
Pentachloronaphthalene	[1321-64-8]	-	0.5	-	-
Pentachloronitrobenzene	[82-68-8]	-	0.5	-	-
Pentachlorophenol (skin, A3 CARCINOGEN, bio)	[87-86-5]	-	0.5	-	-
Pentaerythritol	[115-77-5]	-	10	-	-
Pentane	[109-66-0]	600	1,770	750	2,210
See Appendix 6 for exposure limits set by other organisations					
2-Pentanone (see Methyl propyl ketone)					
Perchloroethylene (A3 CARCINOGEN)	[127-18-4]	50	335	150	1005
See Appendix 6 for exposure limits set by other organisations					
Perchloromethyl mercaptan	[594-42-3]	0.1	0.76	-	-
Perchloryl fluoride	[7616-94-6]	3	13	6	25
Precipitated silica (see Silica-Amorphous)					
Perfluoroisobutylene	[382-21-8]	Ceiling 0.01 ppm (0.082 mg/m3)			
Perlite	[93763-70-3]	-	10[d]	-	-
Petrol (Gasoline) (A3 CARCINOGEN)	[8006-61-9]	300	890	500	1,480
Phenacyl chloride (see a-Chloroacetophenone)					
Phenol (skin)	[108-95-2]	5	19	-	-
Phenothiazine (skin)	[92-84-2]	-	5	-	-
2-Phenoxyethanol	[122-99-6]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
N-Phenyl-beta-naphthylamine (A2 CARCINOGEN)	[135-88-6]	-	-	-	-
m-Phenylenediamine	[108-45-2]	-	0.1	-	-
o-Phenylenediamine (A3 CARCINOGEN)	[95-54-5]	-	0.1	-	-
p-Phenylenediamine (skin)	[106-50-3]	-	0.1	-	-
Phenyl ether vapour	[101-84-8]	1	7	2	14
Phenylethylene (see Styrene, monomer)					
Phenyl glycidyl ether (PGE)	[122-60-1]	1	6.1	-	-
(sen, skin, A3 CARCINOGEN)					
See Appendix 6 for exposure limits set by other organisations					
Phenylhydrazine (skin, sen, A3 CARCINOGEN)	[100-63-0]	0.1	0.44	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m³[c]	STEL ppm[b]	STEL mg/m³[c]
Phenyl mercaptan	[108-98-5]	0.5	2.3	-	-
Phenylphosphine	[638-21-1]	Ceiling 0.05 ppm (0.23 mg/m³)			
Phorate (skin)	[298-02-2]	-	0.05	-	0.2
Phosdrin (see Mevinphos)					
Phosgene (2001)	[75-44-5]	0.02	0.08	0.06	0.25
Phosphine See Appendix 6 for exposure limits set by other organisations	[7803-51-2]	0.3	0.42	1	1.4
Phosphoric acid	[7664-38-2]	-	1	-	-
Phosphorus (yellow)	[7723-14-0]	-	0.1	-	-
Phosphorus oxychloride	[10025-87-3]	0.1	0.63	-	-
Phosphorus pentachloride	[10026-13-8]	0.1	0.85	-	-
Phosphorus pentasulphide	[1314-80-3]	-	1	-	-
Phosphorous pentoxide See Appendix 6 for exposure limits set by other organisations	[1314-56-3]	-	-	-	-
Phosphorus trichloride	[7719-12-2]	0.2	1.1	0.5	2.8
Phthalic anhydride (sen)	[85-44-9]	1	6.1	-	-
m-Phthalodinitrile	[626-17-5]	-	5	-	-
Picloram	[1918-02-1]	-	10	-	-
Picric acid	[88-89-1]	-	0.1	-	-
Pindone	[83-26-1]	-	0.1	-	-
Piperazine dihydrochloride	[142-64-3]	-	5	-	-
Piperidine (skin, 2001)	[110-89-4]	1	3.5	-	-
2-Pivalyl-1,3-indandione (see Pindone)					
Plaster of Paris (see Calcium sulphate)					
Platinum metal Soluble salts, as Pt (sen)	[7440-06-4]	- -	1 0.002	- -	- -
Polychlorinated biphenyls (PCBs) (2001) See Appendix 6 for exposure limits set by other organisations	[1336-36-3]	-	0.1	-	-
Polytetrafluoroethylene decomposition products		-	-[i]	-	-
Polyvinyl chloride See Appendix 6 for exposure limits set by other organisations	[9002-86-2]	-	-	-	-
Portland cement See Appendix 6 for exposure limits set by other organisations	[65997-15-1]	-	10[d]	-	-
Potassium hydroxide	[1310-58-3]	Ceiling 2 mg/m³			
PPAH (see Coal tar pitch volatiles)					
Propane See Appendix 6 for exposure limits set by other organisations	[74-98-6]	Simple asphyxiant - may present an explosion hazard			

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Propane-1,2 diol (2001)	[57-55-6]				
vapour & particulates		150	474	-	-
particulates only		-	10	-	-
Propane sultone (A3 CARCINOGEN)	[1120-71-4]	-	-	-	-
Propargyl alcohol (skin)	[107-19-7]	1	2.3	-	-
β-Propiolactone (A3 CARCINOGEN)	[57-57-8]	0.5	1.5	-	-
Propionic acid	[79-09-4]	10	30	-	-
Propoxur (A3 CARCINOGEN)	[114-26-1]	-	0.5	-	-
2-Propoxyethanol	[2807-30-9]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
2-Propoxyethyl acetate	[20706-25-6]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Propranolol (2001)	[525-66-6]	-	2	-	6
n-Propyl acetate	[109-60-4]	200	835	250	1,040
See Appendix 6 for exposure limits set by other organisations					
Propyl alcohol (skin)	[71-23-8]	200	492	250	614
Propylene	[115-07-1]	Simple asphyxiant, may present an explosion hazard			
Propylene dichloride	[78-87-5]	75	347	110	508
Propylene glycol dinitrate (skin)	[6423-43-4]	0.05	0.34	-	-
Propylene glycol monomethyl ether	[107-98-2]	100	369	150	553
Propylene imine (skin, A3 CARCINOGEN)	[75-55-8]	2	4.7	-	-
Propylene oxide (A3 CARCINOGEN, 2001)	[75-56-9]	5	12	-	-
n-Propyl nitrate	[627-13-4]	25	107	40	172
Propyne (see Methyl acetylene)					
Pyrethrum (sen)	[8003-34-7]	-	5	-	-
Pyridine	[110-86-1]	5	16	-	-
Pyrocatechol (see Catechol)					
Quartz (see Silica-Crystalline)					
Quinone	[106-51-4]	0.1	0.44	-	-
RDX (see Cyclonite)					
Resorcinol	[108-46-3]	10	45	20	90
Rhodium metal	[7440-16-6]	-	1	-	-
Insoluble compounds, as Rh		-	1	-	-
Soluble compounds, as Rh		-	0.01	-	-
See Appendix 6 for exposure limits set by other organisations					
Ronnel	[299-84-3]	-	10	-	-
Rosin core solder thermal decomposition products as a resin acids (colophony) - sensitiser – reduce to the lowest practicable level (2001)					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Rotenone (commercial)	[83-79-4]	-	5	-	-
Rouge		-	10[d]	-	-
Rubber process dust (2001)		-	6	-	-
fume (see reference 15)		-	0.6	-	-
Rubber solvent (Naphtha)		400	1,600	-	-
See Appendix 6 for exposure limits set by other organisations					
Selenium & compounds, as Se (2001)	[7782-49-2]	-	0.1	-	-
Selenium hexafluoride, as Se	[7783-79-1]	0.05	0.2	-	-
Sesone	[136-78-7]	-	10	-	-
Silane (see Silicon tetrahydride)					
Silica-Amorphous					
Diatomaceous earth (uncalcined)	[68855-54-9]	-	10[d]	-	-
Precipitated silica		-	10[d]	-	-
Silica gel		-	10[d]	-	-
Silica-Crystalline (A2 CARCINOGEN)					
See Appendix 6 for exposure limits set by other organisations					
Cristobalite	[14464-46-1]		0.1 Respirable dust		
Quartz	[14808-60-7]		0.2 Respirable dust		
Silica fused	[60676-86-0]		0.2 Inspirable dust		
Tridymite	[15468-32-3]		0.1 Respirable dust		
Tripoli	[1317-95-9]		0.2 Respirable dust of contained respirable quartz		
Silica fume (2001)			2mg/m3 Respirable dust		
Silica fused (see Silica-Crystalline)					
Silica gel (see Silica-Amorphous)					
Silicon	[7440-21-3]	-	10[d]	-	-
Silicon carbide	[409-21-2]	-	10[d]	-	-
Silicon tetrahydride	[7803-62-5]	5	6.6	-	-
See Appendix 6 for exposure limits set by other organisations					
Silver metal	[7440-22-4]	-	0.1	-	-
Soluble compounds, as Ag		-	0.01	-	-
See Appendix 6 for exposure limits set by other organisations					
Soapstone		-	3mg/m3 Respirable dust		
		-	6mg/m3 Inspirable dust		
Sodium azide	[26628-22-8]	Ceiling 0.11 ppm (0.29 mg/m3)			
Sodium bisulphite	[7631-90-5]	-	5	-	-
Sodium 2,4-dichloro-phenoxyethyl sulphate (see Sesone)					
Sodium fluoroacetate (1080) (skin,bio)	[62-74-8]	-	0.05	-	-
Sodium hydroxide	[1310-73-2]	Ceiling 2 mg/m3			
Sodium metabisulphite	[7681-57-4]	-	5	-	-
Starch	[9005-25-8]	-	10[d]	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Stearates		-	10[d]	-	-
Stibine	[7803-52-3]	0.1	0.51	-	-
Stoddard solvent (see White spirits)					
Strontium chromate, as Cr (A2 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[7789-06-2]	-	0.001	-	-
Strychnine	[57-24-9]	-	0.15	-	-
Styrene, monomer (skin) See Appendix 6 for exposure limits set by other organisations	[100-42-5]	50	213	100	426
Subtilisins (Proteolytic enzymes, as 100% pure crystalline enzyme) (sen)	[1395-21-7; 9014-01-1]	Ceiling 0.00006 mg/m3			
Sucrose	[57-50-1]	-	10[d]	-	-
Sulfotep (skin)	[3689-24-5]	-	0.2	-	-
Sulphur dioxide See Appendix 6 for exposure limits set by other organisations	[7446-09-5]	2	5.2	5	13
Sulphur hexafluoride	[2551-62-4]	1,000	5,970	-	-
Sulphuric acid (A2 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[7664-93-9]	-	1	-	-
Sulphur monochloride	[10025-67-9]	Ceiling 1 ppm (5.5 mg/m3)			
Sulphur pentafluoride	[5714-22-7]	Ceiling 0.01 ppm (0.10 mg/m3)			
Sulphur tetrafluoride	[7783-60-0]	Ceiling 0.1 ppm (0.44 mg/m3)			
Sulphuryl fluoride	[2699-79-8]	5	21	10	42
Sulprofos	[35400-43-2]	-	1	-	-
Synthetic mineral fibres		1Respirable fibre per millilitre air and 5mg/m3 Inspirable dust			
Systox (see Demeton)					
2,4,5-T	[93-76-5]	-	10	-	-
Talc (containing no asbestos fibres) See Appendix 6 for exposure limits set by other organisations	[14807-96-6]	-	2mg/m3Respirable dust		
Talc (containing asbestos fibres)		Use asbestos standards			
Tantalum metal	[7440-25-7]	-	5	-	-
Oxide dusts	[1314-61-0]	-	5	-	-
TDI (see Isocyanates)					
TEDP (see Sulfotep)					
Tellurium & compounds, as Te	[13494-80-9]	-	0.1	-	-
Tellurium hexafluoride, as Te	[7783-80-4]	0.02	0.10	-	-
Temephos	[3383-96-8]	-	10	-	-
TEPP (skin)	[107-49-3]	0.004	0.047	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m³[c]	STEL ppm[b]	STEL mg/m³[c]
Terephthalic acid [2001]	[100-21-0]	-	10	-	-
Terphenyls	[26140-60-3]	Ceiling 0.5 ppm (4.7 mg/m³)			
1,1,1,2-Tetrachloro-2,2-difluoroethane See Appendix 6 for exposure limits set by other organisations	[76-11-9]	500	4,170	-	-
1,1,2,2-Tetrachloro-1,2-difluoroethane See Appendix 6 for exposure limits set by other organisations	[76-12-0]	500	4,170	-	-
1,1,2,2-Tetrachloroethane (skin, A3 CARCINOGEN)	[79-34-5]	1	6.9	-	-
Tetrachloroethylene (see Perchloroethylene)					
Tetrachloromethane (see Carbon tetrachloride)					
Tetrachloronaphthalene	[1335-88-2]	-	2	-	-
Tetraethyl lead, as Pb (skin, bio) See Appendix 6 for exposure limits set by other organisations	[78-00-2]	-	0.1[j]	-	-
1,1,1,2-Tetrafluoroethane (HCF 134a) (2001)	[811-97-2]	1000	-	-	-
Tetrafluoroethylene (A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[116-14-3]	-	-	-	-
Tetrahydrofuran (skin) [2001] See Appendix 6 for exposure limits set by other organisations	[109-99-9]	100	295	-	-
Tetramethyl lead, as Pb (skin, bio) See Appendix 6 for exposure limits set by other organisations	[75-74-1]	-	0.15[j]	-	-
Tetramethyl succinonitrile (skin)	[3333-52-6]	0.5	2.8	-	-
Tetranitromethane (skin, A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[509-14-8]	1	8	-	-
Tetrasodium pyrophosphate	[7722-88-5]	-	5	-	-
Tetryl (sen)	[479-45-8]	-	1.5	-	-
Thallium soluble compounds, as Tl (skin)	[7440-28-0]	-	0.1	-	-
4,4'-Thiobis(6-tert-butyl-m-cresol)	[96-69-5]	-	10	-	-
Thioglycolic acid (skin)	[68-11-1]	1	3.8	-	-
Thionyl chloride	[7719-09-7]	Ceiling 1 ppm (4.9 mg/m³)			
Thiram	[137-26-8]	-	1	-	-
Tin metal	[7440-31-5]	-	2	-	-
Oxide & inorganic compounds, except SnH_4, as Sn		-	2	-	-
Organic compounds, as Sn (skin)		-	0.1	-	0.2
Titanium dioxide	[13463-67-7]	-	10[d]	-	-
TNT (see 2,4,6-Trinitrotoluene)					
o-Tolidine (skin, A3 CARCINOGEN)	[119-93-7]	-	-	-	-
Toluene (skin)	[108-88-3]	50	188	-	-
Toluene-2,4-diisocyanate (see Isocyanates)					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
p-Toluenesulpfonyl chloride See Appendix 6 for exposure limits set by other organisations	[98-59-9]	-	-	-	-
o-Toluidine (skin, A3 CARCINOGEN, 2001)	[95-53-4]	0.2	0.89	-	-
m-Toluidine (skin)	[108-44-1]	2	8.8	-	-
p-Toluidine (skin, A3 CARCINOGEN)	[106-49-0]	2	8.8	-	-
Toluol (see Toluene)					
Toxaphene (see Chlorinated camphene)					
Tributyl phosphate	[126-73-8]	0.2	2.2	-	-
Tri-n-butyltin compounds (as TBTO) See Appendix 6 for exposure limits set by other organisations	[56-35-9]	-	-	-	-
Trichloroacetic acid (A3 CARCINOGEN)	[76-03-9]	1	6.7	-	-
1,2,4-Trichlorobenzene	[120-82-1]	Ceiling 5 ppm (37 mg/m^3)			
1,1,1-Trichloroethane (see Methyl chloroform)					
1,1,2-Trichloroethane (skin)	[79-00-5]	10	55	-	-
Trichloroethylene	[79-01-6]	50	269	200	1,070
Trichlorofluoromethane	[75-69-4]	Ceiling 1,000 ppm (5,620 mg/m^3)			
Trichloromethane (see Chloroform)					
Trichloronaphthalene (skin)	[1321-65-9]	-	5	-	-
Trichloronitromethane (see Chloropicrin)					
1,2,3-Trichloropropane (skin, A3 CARCINOGEN)	[96-18-4]	10	60	-	-
1,1,2-Trichloro-1,2,2-trifluoroethane See Appendix 6 for exposure limits set by other organisations	[76-13-1]	1,000	7,670	1,250	9,590
Tricyclohexyltin hydroxide (see Cyhexatin)					
Tridymite (see Silica-Crystalline)					
Triethanolamine (A2 CARCINOGEN)	[102-71-6]	-	5	-	-
Triethylamine (skin) See Appendix 6 for exposure limits set by other organisations	[121-44-8]	3	12	5	20
Trifluorobromomethane	[75-63-8]	1,000	6,090	-	-
Triglycidyl isocyanurate(TGIC) (2001) See Appendix 6 for exposure limits set by other organisations	[2451-62-9]	-	0.08	-	-
Trimellitic anhydride (sen)	[552-30-7]	0.005	0.039	-	-
Trimethylamine See Appendix 6 for exposure limits set by other organisations	[75-50-3]	10	24	15	36
Trimethyl benzene	[25551-13-7]	25	123	-	-
Trimethyl phosphite	[121-45-9]	2	10	-	-
2,4,6-Trinitrophenol (see Picric acid)					
2,4,6-Trinitrophenylmethylnitramine (see Tetryl)					

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m³[c]	STEL ppm[b]	STEL mg/m³[c]
2,4,6-Trinitrotoluene (skin)	[118-96-7]	-	0.5	-	-
Triorthocresyl phosphate (skin)	[78-30-8]	-	0.1	-	-
Triphenyl amine	[603-34-9]	-	5	-	-
Triphenyl phosphate	[115-86-6]	-	3	-	-
Tripoli (see Silica-Crystalline)					
Tungsten, as W	[7440-33-7]				
Insoluble compounds		-	5	-	10
Soluble compounds		-	1	-	-
Turpentine (wood $C_{10}H_{16}$) (sen)	[8006-64-2]	100	556	-	-
Uranium (natural) soluble & insoluble compounds, as U (A1 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[7440-61-1]		0.2	-	-
n-Valeraldehyde	[110-62-3]	50	176	-	-
Vanadium, as V_2O_5	[1314-62-1]				
Respirable dust & fume		-	0.05	-	-
Vegetable oil mists		-	10[d]	-	-
Vinyl acetate (A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[108-05-4]	10	35	20	70
Vinyl benzene (see Styrene)					
Vinyl bromide (A2 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[593-60-2]	5	22	-	-
Vinyl chloride (A1 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[75-01-4]	5	13	-	-
Vinyl cyanide (see Acrylonitrile)					
4-Vinyl cyclohexene (A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[100-40-3]	-	-	-	-
Vinyl cyclohexene dioxide (skin, A3 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[106-87-6]	10	57	-	-
Vinyl fluoride (A2 CARCINOGEN) See Appendix 6 for exposure limits set by other organisations	[75-02-5]	-	-	-	-
Vinylidene chloride See Appendix 6 for exposure limits set by other organisations	[75-35-4]	5	20	20	79
Vinylidene fluoride See Appendix 6 for exposure limits set by other organisations	[75-38-7]	-	-	-	-
Vinyl toluene	[25013-15-4]	50	242	100	483
Warfarin	[81-81-2]	-	0.1	-	-
Welding fumes (Not otherwise classified)		-	5[g]	-	-
White spirits (Stoddard solvent)	[8052-41-3]	100	525	-	-

Substance	CAS # [a]	WORKPLACE EXPOSURE STANDARDS TWA ppm[b]	TWA mg/m3[c]	STEL ppm[b]	STEL mg/m3[c]
Wood dust (sen)					
certain hard woods as beech & oak (A1 CARCINOGEN)		-	1	-	-
Soft wood		-	5	-	10
Xylene (o-, m-, p-isomers) (2001)	[1330-20-7; 95-47-6; 108-38-3; 106-42-3]	50	217	-	-
m-Xylene a,a'-diamine (skin)	[1477-55-0]	Ceiling 0.1 mg/m3			
Xylidine mixed isomers (skin, A3 CARCINOGEN)	[1300-73-8]	0.5	2.5	-	-
Yttrium metal & compounds, as Y	[7440-65-5]	-	1	-	-
Zinc beryllium silicate	[39413-47-3]	-	-	-	-
Zinc chloride fume	[7646-85-7]	-	1	-	2
Zinc chromates, as Cr (A1 CARCINOGEN)	[13530-65-9; 11103-86-9; 37300-23-5]	-	0.01	-	-
Zinc oxide fume	[1314-13-2]	-	5	-	10
Dust		-	10[d]	-	-
Zinc stearate	[557-05-01]	-	-	-	-
See Appendix 6 for exposure limits set by other organisations					
Zirconium & compounds, as Zr	[7440-67-2]	-	5	-	10

NOTES

The following footnotes apply to the tables on pp 26-56. For convenience, these have also been provided on a separate bookmark.

(a) CAS #, Chemical Abstracts Service Registry. A unique numbering identifier is assigned to each individual chemical.

(b) Parts of vapour or gas per million of contaminated air by volume at 25°C and 760 torr.

(c) Milligrams of substance per cubic metre of air.

(d) The value is for inspirable dust containing no asbestos and less than 1% free silica. (See appendix 1).

(e) Fibres not less than 5µm and not more than 100µm in length, less than 3µm in width and with a length to width ratio of no less than 3:1.

(f) Lint-free dust as measured by the vertical elutriator cotton-dust sampler described in the *Transactions of the National Conference on Cotton Dust*, p.33, by J. R. Lynch (May 2, 1970).

(g) A range of airborne contaminants are associated with gas and arc welding. The type of metal being welded, the electrode employed and the welding process will all influence the composition and amount of fume. Gaseous products such as oxides of nitrogen, carbon monoxide and ozone may also be produced. In the absence of toxic elements such as chromium, and where conditions do not support the generation of toxic gases, the fume concentration inside the welder's helmet should not exceed 5 mg/m^3.

(h) Sampled by a method that does not collect vapour.

(i) Thermal decomposition of polytetrafluoroethylene (PTFE, teflon) has been shown to cause polymer fume fever. Although the decomposition products have been studied, no Workplace Exposure Standard is recommended at this stage.

(j) Biological monitoring recommended.

(A1 CARCINOGEN) Confirmed human carcinogen.

(A2 CARCINOGEN) Suspect human carcinogen.

(A3 CARCINOGEN) Confirmed animal carcinogen with unknown relevance to humans.

(2001) 2001 change.

(skin) Skin absorption. (See section 8).

(sen) Sensitiser. (See section 10).

(bio) Exposure can also be estimated by biological monitoring.

Appendix 1: Inspirable and Respirable Dust

INSPIRABLE DUST

Criteria defining inspirable mass fractions have been proposed by the International Standards Organisation (ISO) and by the ACGIH[3]. The definitions describe collection efficiency curves that pass through the following points:

d		0	10	30	60	100	185
% inspirability	ACGIH	100	77	58	51	50	
% inspirability	ISO	100	73	52	34	20	0

Where d is the equivalent aerodynamic diameter of the particle in μm.

Different types of sampling devices, that are specifically designed to conform to either specification, may give conflicting results if a significant proportion of the particles are larger than approximately 30μm. At present there is no one accepted procedure for obtaining a sample that accurately reflects the inspirable mass fraction (under various environmental conditions). For the purpose of these standards, the inspirable dust is to be collected according to the method set out in the Standards Australia publication AS 3640[10].

Two personal sampling heads are recommended: the modified United Kingdom Atomic Energy Authority (UKAEA) and the IOM inspirable dust sampling head developed by the UK Institute of Occupational Medicine, Edinburgh (see figures 1 and 2.)

Personal air sampling pumps to be used with either head should be capable of maintaining a smoth flow of 2 ± 0.1 litres/minute over the entire sampling period.

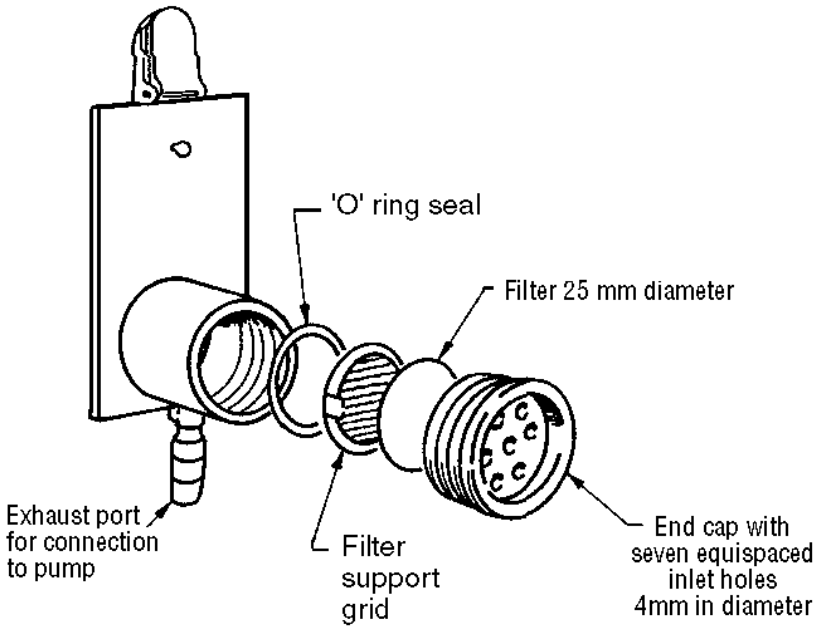

FIGURE 1: MODIFIED UKAEA PERSONAL SAMPLING HEAD

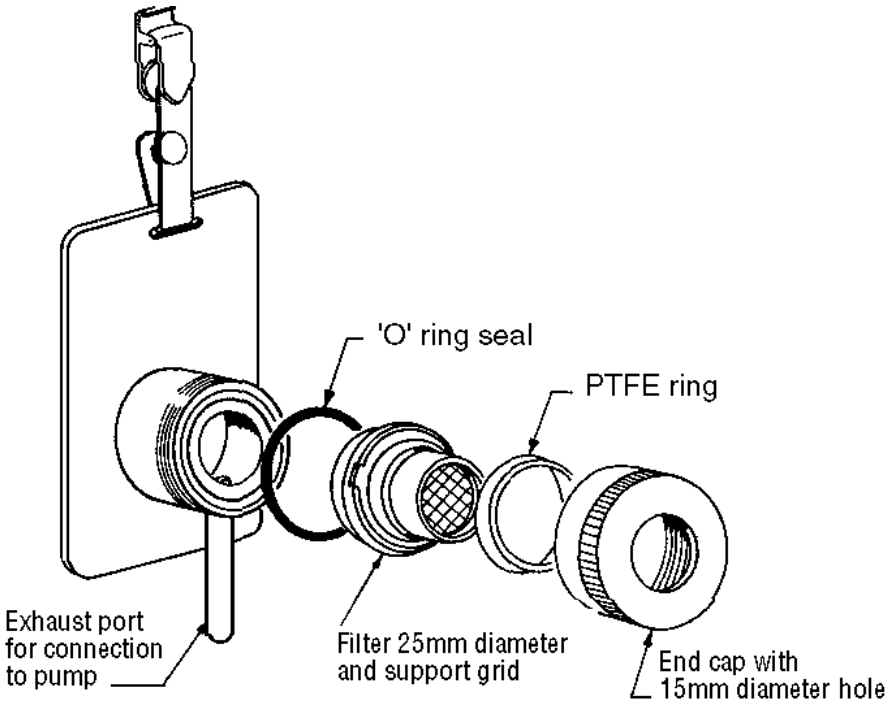

FIGURE 2: IOM INSPIRABLE DUST SAMPLING HEAD

RESPIRABLE DUST

Various systems have been used to define respirable dust fractions with the British Medical Research Council convention up until recently being widely used. Some organisations have updated the system they use to define the respirable dust fraction and altered the value of the respirable standards to accommodate this change. For example the UK Health and Safety Executive[14] have adopted the ISO/CEN respirable dust convention and made a corresponding change to the numerical value of the respirable dust standards to maintain the same level of control. While changes are being considered in NZ, for the purpose of these standards, respirable dust samples are to be collected according to the method set out in the Standards Australia Publication AS 2985[11]. This standard refers to a sampling efficiency curve that passes through the following points

d	0	1	2	3	4	5	6	7
Respirable %	100	98	92	82	68	50	28	0

Where d is the equivalent aerodynamic diameter of the particle in μm.

This distribution is known as the "Johannesburg Curve".

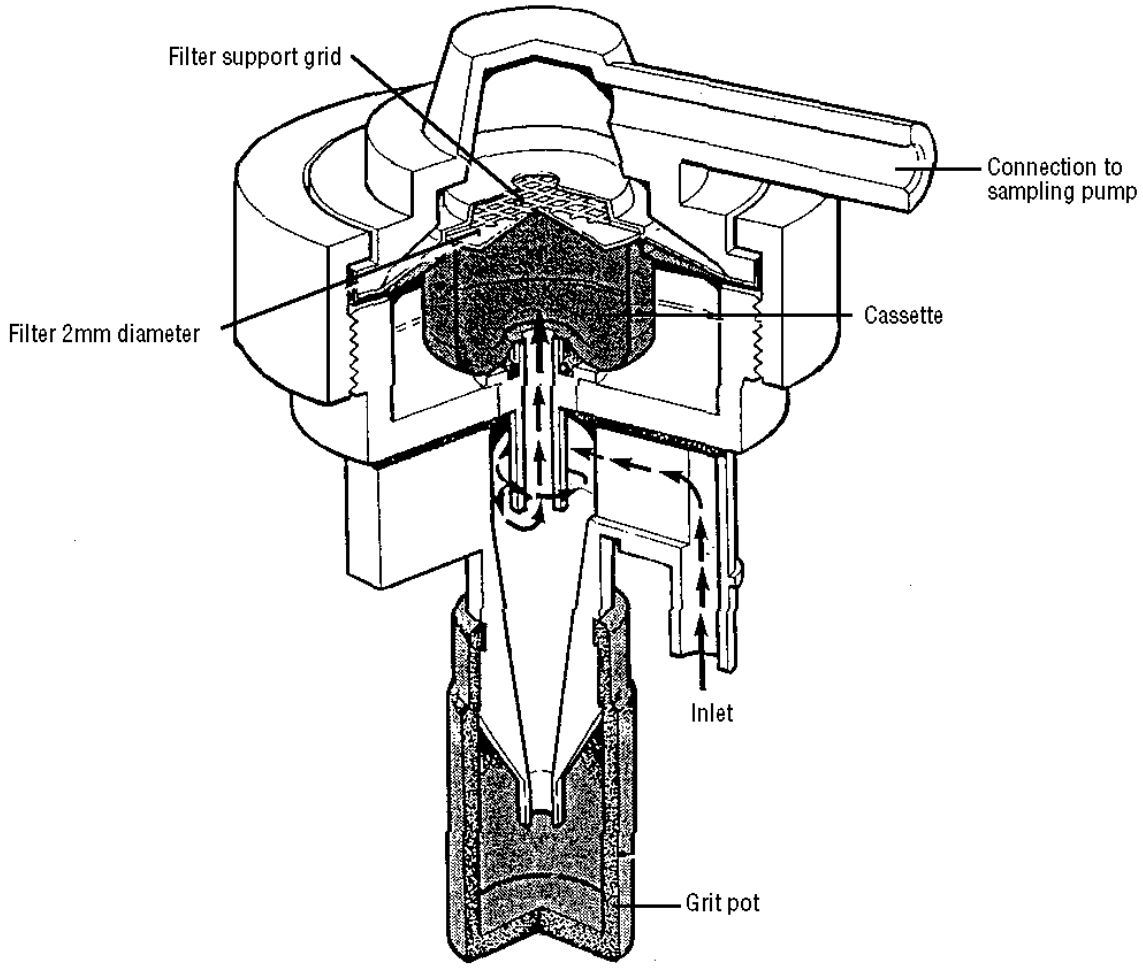

FIGURE 3: CYCLONE ELUTRIATOR

The respirable dust fraction is to be collected with a device that is capable of collecting a sample that conforms with the above curve. One system is a miniature cyclone (see figure 3), with a pump that can maintain a smoothed flow of 1.9 ± 0.1 litres/minute over the entire sampling period.

The method to be followed for the determination of respirable dust levels is set out in the Standards Australia publication AS 2985[11].

Appendix 2: Mixed Exposures

If substances have a similar toxicologic action, then the following procedure may be used to assess the combined effect. For the mixture to be within the combined WES:

$$\frac{C_1}{WES_1} + \frac{C_2}{WES_2} + \frac{C3}{WES_3} + \ldots \frac{Cn}{WES_n}$$ is to be less than 1

Where C is the occupational exposure and WES is the corresponding Workplace Exposure Standard.

Substance	*TWA Exposure (mg/m³)*	*WES-TWA*
Toluene	70	188
Xylene	190	217

Both substances act on the central nervous system. The WES for mixtures is calculated as follows:

70/188 + 190/217 = 1.2

The WES for mixtures is then exceeded.

Appendix 3: Rubber Fume and Rubber Process Dust

The standards adopted for rubber process dust and rubber fume are those set by the UK Health and Safety Executive[14].

Rubber process dust refers to dust that is generated during the manufacture of goods using natural rubber or synthetic elastomers. Excluded from the definition are substances for which a specific workplace exposure standard has been assigned. Unless information to the contrary is available, these substances should be considered to be additive to rubber process dust and the method for assessing mixed exposures set out in appendix 2 applied. A personal inspirable dust sample is collected for comparison against the standard of 6mg/m^3 for rubber process dust.

Rubber fume refers to any fume that is evolved during the blending, milling and curing of natural rubbers or synthetic elastomers. The limit of 0.6 mg/m^3 relates to the cyclohexane soluble material determined by the method: *Rubber Fume in Air, Measured as Total Particulates and Cyclohexane Soluble Material*[15].

Appendix 4: Lead Biological Exposure Indices

The Occupational Safety and Health Service publication *Guidelines for the Medical Surveillance of Lead Workers* specifies blood lead levels applicable for the monitoring of lead exposure in the workplace. The overall objective of the surveillance outlined in the guidelines is to maintain the blood lead levels of all workers below 1.5 μ mol/litre whole blood. Medical surveillance, including blood lead monitoring, is extended to all those working with lead in a process that may result in blood lead levels above 1.5 μ mol/litre whole blood.

A worker will normally be suspended by the departmental medical practitioner where:

(a) A single blood lead result is 3.2 μ mol/litre whole blood or greater; or

(b) Three consecutive monthly estimations are 2.6 μ mol/litre whole blood or above.

Appendix 5: Carbon Monoxide

Exposure to carbon monoxide should be controlled to maintain a carboxyhaemoglobin (COHb) level below 3.5% (the Biological Exposure Index for CO). Under most conditions this will be achieved if the average level over an 8-hour day does not exceed 25 ppm, however there is also a need to control brief periods of high CO exposure. The following guidelines on short-term exposures are recommended:

SHORT-TERM EXCURSIONS FOR CO EXPOSURE

Concentration (ppm)	*Exposure Period*
200 ppm	15 minutes
100 ppm	30 minutes
50 ppm	60 minutes

- The CO level should not exceed 400 ppm at any time during the day

•• The **sum** of the exposure periods during the day at a particular level should not (in total) exceed the period indicated.

Appendix 6: Workplace Exposure Standards Proposed by Other Organisations

The New Zealand Workplace Exposure Standards have been endorsed after due consideration of the supporting information available. As with the standards listed by other national organisations, the majority of the New Zealand standards have been adopted from the ACGIH TLVs[3,4]. In some instances the current New Zealand WES is higher (less stringent) than the corresponding standard set by other organisations. The following list identifies a number of these situations and notes workplace exposure standards that have not yet been evaluated in New Zealand. More detailed information can be found elsewhere[3,13].

Abbreviations used are:

HSE OES	Health and Safety Executive Occupational Exposure Standard
HSE MEL	Health and Safety Executive Maximum Exposure Limit
NIOSH REL	National Institute for Occupational Safety and Health Recommended Exposure Limits
DFG MAK	Federal Republic of Germany Maximum Concentration Values in the Workplace
OSHA PEL	Occupational Safety and Health Administration Permissible Exposure Limits

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Acetamide	NZ WES	-	-	-	-
	Netherlands	10	25	-	-
Acetone	NZ WES	500	1,185	1,000	2,375
	NIOSH REL	250	590	-	-
Acetone cyanohydrin	NZ WES	-	-	-	-
	NIOSH REL	-	-	1	4
	ACGIH TLV	(as CN)		4.7	5

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Acetonitrile	NZ WES	40	67	60	101
	NIOSH REL	20	34	-	-
Acetophenone	NZ WES	-	-	-	-
	ACGIH TLV	10	49	-	-
Acetylene tetrabromide	NZ WES	1	14	-	-
	HSE OES	0.5	7.2	-	-
Acrolein	NZ WES	0.1	0.23	-	-
	ACGIH TLV	Ceiling 0.1 ppm			
Acrylic acid polymer	NZ WES	-	-	-	-
	DFG MAK	-	0.05 Respirable dust		-
Acrylonitrile	NZ WES	2	4.3	-	-
	NIOSH REL	1		10	
Adipic acid	NZ WES	-	-	-	-
	ACGIH TLV	-	5	-	-
Adiponitrile	NZ WES	-	-	-	-
	ACGIH TLV	2	8.8	-	-
Aflatoxins	NZ WES	-	-	-	-
	Netherlands	-	0.000005	-	-
Allyl alcohol	NZ WES	2	4.8	4	9.5
	ACGIH TLV	0.5	1.2	-	-
Allyl glycidyl ether (AGE)	NZ WES	5	23	10	47
	ACGIH TLV	1	4.7	-	-
Ammonia	NZ WES	25	17	35	24
	DFG MAK	20	14	-	-
Ammonium perfluoro-octanoate	NZ WES	-	0.1	-	-
	ACGIH TLV	-	0.01	-	-
p-Aramide	NZ WES	-	-	-	-
	HSE OES	-	0.5 fibre/ml	-	-
Arsenic & soluble compounds, as As	NZ WES	-	0.05	-	-
	ACGIH TLV	-	0.01	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Arsine	NZ WES	0.05	0.16	-	-
	NIOSH REL		Ceiling 0.002 mg/m³		
Asbestos (all forms)	ACGIH TLV	0.1 fibre/cc			
	OSHA PEL	0.1 fibre/cc			
Azodicarbonamide	NZ WES	-	-	-	-
	HSE MEL	-	1	-	3
Barium sulphate	NZ WES	-	10[(d)]	-	-
	DFG MAK		4	-	-
Benzene	NZ WES	5	16	-	-
	OSHA PEL	1	3	5	15
	NIOSH REL	0.1	0.32	1	3.2
Benzotrichloride	NZ WES	-	-	-	-
	ACGIH TLV		Ceiling 0.1 ppm (0.8 mg/m³)		
Benzoyl chloride	NZ WES	-	-	-	-
	ACGIH TLV		Ceiling 0.5 ppm (2.8 mg/m³)		
Benzyl Acetate	NZ WES	-	-	-	-
	ACGIH TLV	10	61	-	-
Beryllium & compounds, as Be	NZ WES	-	0.002	-	-
	NIOSH REL		Ceiling 0.0005 mg/m³		
Bis[2-dimethylaminoethyl] ether (DMAEE)	NZ WES	-	-	-	-
	ACGIH TLV	0.05	0.33	0.15	0.98
1,3-Butadiene	NZ WES	10	22	-	-
	OSHA PEL	1	-	5	-
2-Butoxyethanol (EGBE)	NZ WES	25	121	-	-
	NIOSH REL	5	24	-	-
2-Butoxyethyl acetate	NZ WES	-	-	-	-
	NIOSH REL	5	21	-	-
	DFG MAK	20	130	-	-
tert-Butyl acetate	NZ WES	200	950	-	-
	DFG MAK	20	96	-	-
Butyl acrylate	NZ WES	10	52	-	-
	ACGIH TLV	2	11	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
tert-Butyl alcohol	NZ WES	100	303	150	455
	DFG MAK	20	62	-	-
sec-Butylamine	NZ WES		-	-	- -
	DFG MAK		5	15	- -
tert-Butylamine	NZ WES		-	-	- -
	DFG MAK		5	15	- -
n-Butyl glycidyl ether (BGE)	NZ WES	25	133	-	-
	NIOSH REL	-	-	5.6	30
p-tert-Butyltoluene	NZ WES	10	61	20	121
	ACGIH TLV	1	6.1	-	-
n-Butyronitrile	NZ WES	-	-	-	-
	NIOSH REL		8	22	- -
Carbon disulphide	NZ WES	10	31	-	-
	NIOSH REL	1	3	10	30
	DFG MAK	5	16	-	-
Cetylmercaptan	NZ WES	-	-	-	-
	NIOSH REL	-	-	0.5	5.3
Chlordecone	NZ WES	-	-	-	-
	NIOSH REL	-	0.001	-	-
1-Chloro-1,1-difluoroethane	NZ WES	-	-	-	-
	DFG MAK	1,000	4,200	-	-
Chlorodifluoromethane	NZ WES	1,000	3,540	-	-
	DFG MAK	500	1,800	-	-
Chloroform	NZ WES	2	9.9	-	-
	DFG MAK	0.5	2.5	-	-
b-Chloroprene	NZ WES	10	36	-	-
	NIOSH REL	-	-	1	3.6
Chlorotrifluoromethane	NZ WES	-	-	-	-
	DFG MAK	1000	4300	-	-
Chromium (VI) compounds, as Cr, water-soluble & certain water insoluble	NZ WES	-	0.05	-	-
	NIOSH REL	-	0.001	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Coal dust	NZ WES	3mg/m³ Respirable dust			
	ACGIH TLV		0.4 mg/m³ Respirable dust – Anthracite 0.9 mg/m³ Respirable dust - Bituminous		
Coal tar pitch volatiles,					
as benzene solubles	NZ WES	-	0.2	-	-
as cyclohexane solubles	NIOSH REL	-	0.1	-	-
Cobalt metal dust & fume,	NZ WES	-	0.05	-	-
as Co	ACGIH TLV	-	0.02	-	-
Copper fume	NZ WES	-	0.2	-	-
	OSHA PEL	-	0.1	-	-
- 1	- -				
Crotonaldehyde	NZ WES	2	5.7	-	-
	ACGIH TLV		Ceiling 0.3 ppm (0.86 mg/m³)		
Cyanogen chloride	NZ WES		Ceiling 0.3 ppm (0.75 mg/m³)		
	NIOSH REL		Ceiling 0.03 ppm (0.06 mg/m³)		
Cyclohexylmercaptan	NZ WES	-	-	-	-
	NIOSH REL	-	-	0.5	2.4
Cyclonite	NZ WES	-	1.5	-	-
	ACGIH TLV	-	0.5	-	-
2,4-D	NZ WES	-	10	-	-
	DFG MAK	-	1	-	-
Decylmercaptan	NZ WES	-	-	-	-
	NIOSH REL	-	-	0.5	3.6
1,2-Dibromo-3-chloro	NZ WES	-	-	-	-
propane (DBCP)	OSHA PEL	-	0.001	-	-
2-N-Dibutylaminoethanol	NZ WES	2	14	-	-
	ACGIH TLV	0.5	3.5	-	-
p-Dichlorobenzene	NZ WES	25	153	50	306
	ACGIH TLV	10	60	-	-
1,4-Dichloro-2-butene	NZ WES	-	-	-	-
	ACGIH TLV	0.005	0.025	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
1,1-Dichloroethane	NZ WES	200	810	250	1,010
	OSHA PEL	100	400	-	-
Dicyclopentadiene	NZ WES	5	27	-	-
	DFG MAK	0.5	2.7	-	-
Diethanolamine	NZ WES	3	13	-	-
	ACGIH TLV	0.46	2	-	-
Diethylamine	NZ WES	10	30	25	75
	ACGIH TLV	5	15	15	45
2-Diethylaminoethanol	NZ WES	10	48	-	-
	ACGIH TLV	2	9.6	-	-
Diethylene glycol	NZ WES	23	101	-	-
	ACGIH TLV	10	44	-	-
Diethylene glycol dimethyl ether	NZ WES	-	-	-	-
	DFG MAK	5	28	-	-
Diethylene glycol monobutyl ether	NZ WES	-	-	-	-
	DFG MAK	-	100	-	-
Diethylene glycol monobutyl ether acetate	NZ WES	-	-	-	-
	NETHERLANDS	15	130	30	250
Diethylene glycol mono-methyl ether	NZ WES	-	-	-	-
	NETHERLANDS	9	45	-	-
Dimethylamine	NZ WES	10	18	-	-
	DFG MAK	2	3.7	-	-
Dimethylethoxysilane	NZ WES	-	-	-	-
	ACGIH TLV	0.5	2.1	1.5	6.4
Dimethyl sulphoxide	NZ WES	-	-	-	-
	NETHERLANDS	50	150	-	-
Dinitrotoluene	NZ WES	-	1.5	-	-
	ACGIH TLV	-	0.2	-	-
2,4-Dinitrotoluene	NZ WES	-	-	-	-
	NIOSH REL	-	1.5	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
3,5-Dinitrotoluene	NZ WES	-	-	-	-
	NIOSH REL	-	1.5	-	-
EPN	NZ WES	-	0.5	-	-
	NIOSH REL	-	0.1	-	-
2-Ethoxyethyl acetate (EGEEA)	NZ WES	5	27	-	-
	NIOSH REL	0.5	1.8	-	-
Ethyl alcohol	-				
	NZ WES	1,000	1,880	-	-
	DFG MAK	500	960	-	-
Ethylamine	NZ WES	10	18	-	-
	ACGIH TLV	5	9.2	15	27.6
Ethyl tert-butyl ether	NZ WES	-	-	-	-
	ACGIH TLV	5	21	-	-
Ethyl chloride	NZ WES	1,000	2,640	-	-
	ACGIH TLV	100	264	-	-
Ethyl chloroformate	NZ WES	-	-	-	-
	HSE OEL	1	4.5	-	-
Ethyl cyanoacrylate	NZ WES	-	-	-	-
	ACGIH TLV	0.2	1	-	-
Ethylene dibromide	NZ WES	0.5	3.9	-	-
	NIOSH REL	0.045	-	0.13	-
Ethylene dichloride	NZ WES	5	21	-	-
	NIOSH REL	1	4	2	8
Ethylene glycol isopropyl ether acetate	NZ WES	-	-	-	-
	NETHERLANDS	10	60	20	120
2-Ethylhexyl chloroformate	NZ WES	-	-	-	-
	HSE OES	1	8	-	-
Ethyl Methacrylate	NZ WES	-	-	-	-
	NETHERLANDS	10	46	-	-
Flour dust	NZ WES	-	-	-	-
	ACGIH TLV	-	0.5	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Fluorine	NZ WES	1	1.6	2	3.1
	OSHA PEL	0.1	0.2	-	-
Fluoroxene	NZ WES	-	-	-	-
	NIOSH TLV	-	-	2 (60 min STEL)	10
Formaldehyde	NZ WES		Ceiling 1ppm (1.2 mg/m³)		
	NIOSH REL		0.016	-	0.1 -
	ACGIH TLV		Ceiling 0.3 ppm		
Furfuryl alcohol	NZ WES	10	40	15	60
	HSE OES	5	20	15	61
Gallium Arsenide	NZ WES	-	-	-	-
	NIOSH REL	-	-	-	0.002
Glycidol	NZ WES	25	76	-	-
	ACGIH TLV	2	6.1	-	-
Glycidyl methacrylate	NZ WES	-	-	-	-
	NETHERLANDS	0.05	0.24	-	-
Graphite, all forms except graphite fibres	NZ WES	-	3 Respirable dust		
	DFG MAK	-	1.5 Respirable dust		
Heptachlor	NZ WES	-	0.5	-	-
	ACGIH TLV	-	0.05	-	-
Heptane (n-Heptane)	NZ WES	400	1,640	500	2,050
	NIOSH REL	85	350	440	1800
Hexachlorobenzene	NZ WES	-	-	-	-
	ACGIH TLV	-	0.002	-	
Hexane isomers other than n-Hexane	NZ WES	500	1,760	1,000	3,500
	NIOSH REL	100	350	510	1800
1,6-Hexanediamine	NZ WES	-	-	-	-
	ACGIH TLV	0.5	2.3	-	-
1-Hexene	NZ WES	-	-	-	-
	ACGIH TLV	30	130	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Hydrogen selenide, as Se	NZ WES	0.05	0.16	-	-
	DFG MAK	0.015	0.05	-	-
Hydroquinone	NZ WES	-	2	-	-
	NIOSH REL	-	-	-	2
2-Hydroxyethyl acrylate	NZ WES	-	-	-	-
	NETHERLANDS	0.05	0.24	-	-
2-Hydroxyethyl methacrylate	NZ WES	-	-	-	-
	NETHERLANDS	0.5	0.24	-	-
Iron pentacarbonyl, as Fe	NZ WES	0.1	0.23	0.2	0.45
HSE OES	0.01	0.08	-	-	
Isobutane	NZ WES	-	-	-	-
	ACGIH	800	1900	-	-
Isobutyl acetate	NZ WES	150	713	-	-
	DFG MAK	100	489	-	-
Isobutylamine	NZ WES	-	-	-	-
	DFG MAK	5	15	-	-
Isobutyl methacrylate	NZ WES	-	-	-	-
	NETHERLANDS	10	59	-	-
Isopropoxyethanol	NZ WES	25	106	-	-
	DFG MAK	5	22	-	-
Isopropyl alcohol	NZ WES	400	983	500	1,230
DFG MAK	200	500	-	-	
Isopropyl chloroformate	NZ WES	-	-	-	-
	HSE OES	1	5.1	-	-
Kerosene	NZ WES		-	-	- -
	NIOSH REL		-	100	- -
Lead, inorganic dusts & fumes, as Pb	NZ WES	-	0.1	-	-
	OSHA PEL	-	0.05	-	-
Magnesium oxide fume	NZ WES	-	10	-	-
	DFG MAK	-	4	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Maleic anhydride	NZ WES	0.25	1.0	-	-
	ACGIH TLV	0.1	0.4	-	-
Manganese dust & compounds, as Mn	NZ WES	-	1	-	-
	ACGIH TLV	-	0.2	-	-
Fume, as Mn	NZ WES	-	1	-	3
	ACGIH TLV	-	0.2	-	-
Mesityl oxide	NZ WES	15	60	25	100
NIOSH REL	10	40	-	-	
Methoxyacetic acid	NZ WES	-	-	-	-
	DFG MAK	5	19	-	-
2-Methoxyethanol	NZ WES	5	16	-	-
	NIOSH REL	0.1	0.3	-	-
2-Methoxyethyl acetate	NZ WES	5	24	-	-
	NIOSH REL	0.1	0.5	-	-
2-Methoxy-1-propanol	NZ WES	-	-	-	-
	DFG MAK	20	75	-	-
1-Methoxypropyl-2-acetate	NZ WES	-	-	-	-
	DFG MAK	50	270	-	-
2-Methoxypropyl-1-acetate	NZ WES	-	-	-	-
	DFG MAK	20	110	-	-
Methyl acrylate	NZ WES	10	35	-	-
	ACGIH TLV	2	7	-	-
Methylamine	NZ WES	10	13	-	-
	ACGIH TLV	5	6.4	15	19
Methyl bromide	NZ WES	5	19	-	-
	ACGIH TLV	1	3.9	-	-
Methyl tert-butyl ether	NZ WES	-	-	-	-
	HSE OES	25	92	75	276
Methyl n-butyl ketone	NZ WES	5	20	-	-
	NIOSH REL	1	4	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Methyl chloroacetate	NZ WES	-	-	-	-
	DFG MAK	1	4.5	-	-
Methyl 2-cyanoacrylate	NZ WES	2	9.1	4	18
ACGIH TLV	0.2	1	-	-	
Methylene chloride	NZ WES	50	174	-	-
	OSHA PEL	25	-	125	-
Methyl isobutyl ketone	NZ WES	50	205	75	307
	DFG MAK	20	83	-	-
Methyl isocyanate	NZ WES	0.02	0.047	-	-
	DFG MAK	0.01	0.024	-	-
Methyl vinyl ketone	NZ WES	-	-	-	-
	ACGIH TLV	-	-	0.2	0.6
Mica	NZ WES	-	3 Respirable dust		
	NOHSC	-	2.5 Inspirable dust		
Nickel metal	NZ WES	-	1	-	-
	NIOSH REL	-	0.015	-	-
Soluble compounds, as Ni	NZ WES	-	0.1	-	-
	NIOSH REL	-	0.015	-	-
Nickel carbonyl, as Ni	NZ WES	0.05	0.12	-	-
	OSHA PEL	0.001	0.007	-	-
Nitrogen dioxide	NZ WES	3	5.6	5	9.4
	NIOSH REL	-	-	1	1.8
Octane	NZ WES	300	1,400	375	1,750
NIOSH REL	75	350	385	1800	
Parathion	NZ WES	-	0.1	-	-
	NIOSH REL	-	0.05	-	-
Pentane	NZ WES	600	1,770	750	2,210
NIOSH REL	120	350	610	1800	
Perchloroethylene	NZ WES	50	335	150	1005
ACGIH TLV	25	170	100	685	

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
2-Phenoxyethanol	NZ WES	-	-	-	-
	DFG MAK	20	110	-	-
Phenyl mercaptan	NZ WES	0.5	2.3	-	-
	NIOSH REL	-	-	0.1	0.5
Phosphine	NZ WES	0.3	0.42	1	1.4
	DFG MAK	0.1	0.14	-	-
Phosphorous pentoxide	NZ WES	-	-	-	-
	DFG MAK	-	1	-	-
	HSE OES	-	-	-	0.2
Polychlorinated biphenyls (PCB)	NZ WES	-	0.1	-	-
Polychlorobiphenyls	NIOSH REL	-	0.001	-	-
Polyvinyl chloride	NZ WES	-	-	-	-
	DFG MAK		1.5 Respirable dust		
Portland cement	NZ WES	-	10	-	-
	DFG MAK	-	5	-	-
Propane	NZ WES	Simple asphyxiant - may present an explosion hazard			
	OSHA PEL	1000	1800	-	-
2-Propoxyethanol	NZ WES	-	-	-	-
	DFG MAK	20	86	-	-
2-Propoxyethyl acetate	NZ WES	-	-	-	-
	DFG MAK	20	120	-	-
n-Propyl acetate	NZ WES	200	835	250	1,040
	DFG MAK	100	420	-	-
Rhodium metal	NZ WES	-	1	-	-
	OSHA PEL	-	0.1	-	-
Insoluble compounds, as Rh	NZ WES	-	1	-	-
SHA PEL -	0.1 - -				
Soluble compounds, as Rh	NZ WES	-	0.01	-	-
	OSHA PEL	-	0.001	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Rubber solvent (Naphtha)	NZ WES	400	1,600	-	-
	OSHA PEL	100	400	-	-
Silica-Amorphous	NZ WES	-	10	-	-
	DFG MAK	-	4	-	-
Silica - Crystalline	ACGIH TLV		0.05 Respirable dust		
Silicon tetrahydride	NZ WES	5	6.6	-	-
	HSE OES	0.5	0.67	1	1.3
Silver metal	NZ WES	-	0.1	-	-
	OSHA PEL	-	0.01	-	-
Strontium chromate, as Cr	NZ WES	-	0.001	-	-
	ACGIH TLV	-	0.0005	-	-
Styrene, monomer	NZ WES	50	213	100	426
	ACGIH TLV	20	85	40	170
Sulphur dioxide	NZ WES	2	5.2	5	13
	DFG MAK	0.5	1.3	-	-
Sulphuric acid	NZ WES	-	1	-	-
	DFG MAK	-	0.1	-	-
Talc (containing no asbestos fibres)	NZ WES	-	2 Respirable dust		
	HSE OEL	-	1 Respirable dust		
1,1,1,2-Tetrachloro-2,2 -difluoroethane	NZ WES	500	4,170	-	-
	HSE OEL	100	847	100	847
1,1,2,2-Tetrachloro-1,2-difluoroethane	NZ WES	500	4,170	-	-
	HSE OEL	100	847	100	847
Tetraethyl lead, as Pb	NZ WES	-	0.1	-	-
	DFG MAK	-	0.05	-	-
Tetrafluoroethylene	NZ WES	-	-	-	-
	ACGIH TLV	2	8.2	-	-
Tetrahydrofuran	NZ WES	100	295	-	-
	DFG MAK	50	150	-	-

		TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Tetramethyl lead, as Pb	NZ WES	-	0.15	-	-
	DFG MAK	-	0.05	-	-
Tetranitromethane	NZ WES	1	8	-	-
	ACGIH TLV	0.005	0.004	-	-
p-Toluenesulpfonyl chloride	NZ WES	-	-	-	-
	HSE OES	-	-	-	5
Tri-n-butyltin compounds (as TBTO)	NZ WES	-	-	-	-
	DFG MAK	0.0021	0.05	-	-
1,1,2-Trichloro-1,2,2-trifluoroethane	NZ WES	1,000	7,670	1,250	9,590
	DFG MAK	500	3900	-	-
Triethylamine	NZ WES	3	12	5	20
	ACGIH TLV	1	4.1	3	12.4
Triglycidyl isocyanurate(TGIC)	NZ WES	-	0.08	-	-
	ACGIH TLV	-	0.05	-	-
Trimethylamine	NZ WES	10	24	15	36
	ACGIH TLV	5	12	15	36
Uranium (natural) soluble & insoluble compounds, as U	NZ WES	-	0.2	-	-
	OSHA PEL	-	0.05	-	-
Vinyl acetate	NZ WES	10	35	20	70
	NIOSH TLV	-	-	4	15
Vinyl bromide	NZ WES	5	22	-	-
	ACGIH TLV	0.5	2.2	-	-
Vinyl chloride	NZ WES	5	13	-	-
	ACGIH TLV	1	2.3	-	-
4-Vinyl cyclohexene	NZ WES	-	-	-	-
	ACGIH TLV	0.1	0.44	-	-
Vinyl cyclohexene dioxide	NZ WES	10	57	-	-
	ACGIH TLV	0.1	0.57	-	-
Vinyl fluoride	NZ WES	-	-	-	-
	ACGIH TLV	1	1.9	-	-

Vinylidene chloride	NZ WES	5	20	20	79
	DFG MAK	2	8	-	-
Vinylidene fluoride	NZ WES	-	-	-	-
	NIOSH REL	1	-	5	-
Zinc stearate	NZ WES	-	-	-	-
	HSE OEL	-	10	-	-

Biological Exposure Indices

1. Introduction

Biological monitoring — the measurement of a substance or its metabolites in body fluids such as urine or blood — provides a complementary approach to air monitoring for the estimation of exposure to workplace contaminants.

A **Biological Exposure Index (BEI)** is defined as a corollary to the WES. *If a worker's inhalation exposure is equal to the WES, and he/she is engaged in moderate work, then the BEI represents the expected level of the biological determinant*. In most cases, the BEI has been derived from the observed relationship between the measured exposure and the biological level, but in some instances the relationship between the biological level and the potential health effects has been approached more directly.

Depending on the pharmacokinetics of the substance, the results from the biological determination may reflect very recent acute exposure, the average exposure over the last day(s), or long-term cumulative exposure. The BEIs listed assume that the exposure has been reasonably steady and that an 8-hour day, 5-day week has been worked. Extrapolation to other exposures can be made but only with a clear understanding of the relationship between absorption, metabolism, and elimination.

Biological monitoring has been widely used to monitor the uptake of cumulative toxins (e.g. lead, mercury, organophosphate insecticides). It also may be employed effectively where there is a significant potential for increased uptake as a result of skin absorption, increased respiratory rate, or exposure outside of the workplace. The effectiveness of measures taken to limit uptake may in some cases be assessed with biological tests. As with air monitoring, the design of the protocol and interpretation of results should only be done by a person with the appropriate qualifications and experience. The fact that a BEI has been listed for a particular substance does not imply that biological monitoring is necessary. An apprasial of the exposure should be made before considering monitoring requirements.

For a biological assay to be a reliable indicator of exposure to a substance, several conditions must be satisfied. The fate of the substance in the human body must have been adequately researched and the time/concentration relationship of the proposed determinant found. A dose-response relationship must exist but it need not be linear. It is not essential that the concentration of the determinant be zero in cases where there is no occupational exposure, as long as the increase is quantitatively observable above the background level. The biological assay must be sensitive and specific. While the concentration of the major metabolite may be high, and therefore easily detected, if it is a metabolite that is common to several substances the determination of the unaltered substance, or minor metabolite, may be preferable. The biological assay is often performed at a remote laboratory, therefore the determinant must be stable in the biological fluid.

2. Assigned Biological Exposure Indices

Generally a BEI associated with only one assay is given for exposure to each substance, even though there may be several possible ways of estimating exposure. Preference has been given to urinary assays over more invasive blood tests but factors such as the stability of the sample and the possiblity of interferences have also been considered. Cultural sensitivity of the worker towards submitting a particular type of sample may also influence the selection of the biological monitoring procedure. Alternative methods may be available, especially for monitoring the exposure to solvents [4,12].

For the routine surveillance of exposure to some substances, biological monitoring may be preferred over air sampling. For example, if the substance has a long half-time in the body, the biological monitoring assay will give a result that reflects an integrated exposure. In other cases the equivalent air sampling procedure may, because of the typical work practices or sampling difficulties encountered, give less reliable results.

Quantitative interpretation of biological monitoring results is often difficult. The quality of the information may be improved if the measurements obtained from several workers with similar exposure, or serial determinations on an individual worker, are considered.

Before undertaking a biological monitoring exercise, it is essential that background information be obtained, including data on the pharmacokinetics of the substance, interferences, and background levels of the determinant. The following two references are recommended as a source of relevant background material:

(a) ACGIH *Documentation of the Threshold Limit Values and Biological Exposure Indices*[2],

(b) *Industrial Chemical Exposure, Guidelines for Biological Monitoring*[12].

3. Sample Collection

It is important to observe the timing of sample collection that has been indicated for each determination. The level of a substance, or its metabolic products, will vary with time and the biological index in some situations is only applicable if the timing of sample collection is closely adhered to. Assuming that there has been continual exposure over the working day, the following sampling periods are defined:

Prior to Shift. Following a period of 16 hours with no exposure.

End of Shift. The last two hours to immediately following the end of the working day.

End of Work Week. After at least four days with exposure.

If the exposure has been confined to a portion of the working day, then it may be necessary to adjust the timing, but it must be considered that the estimation of exposure may be compromised. Contamination of the sample may take place during collection as a result of inadequate cleaning of the skin prior to taking a blood sample, or other inadvertent contamination of a specimen. Loss of sample integrity on storage and transport may occur through the use of an inappropriate container. Further details of the procedure to be followed for sample collection and handling should be obtained from the laboratory that is to carry out the analysis.

4. Interpretation of Results

Biological monitoring data must be interpreted with some caution. There are several reasons why the levels of the determinant may vary given identical exposure situations. Workers may differ in size, physical fitness and work practices resulting in differing uptakes through variations in respiration rate and skin absorption. Further, there may be inter-individual differences in metabolism and elimination rates of the absorbed substance or determinant.

The concentration of the substance in air will fluctuate within and between workdays. From uptake to elimination there will be some smoothing effect but this need not mirror the integration that has been applied by time-weighting the air sampling result. For the relationship between the air level and biological determinant to hold over a range of air levels, the elimination rate must reflect the rate of uptake. This does not always hold. In some cases a particular step in the metabolic process may become saturated or may be inhibited by the presence of another substance.

Further advice on the application of biological monitoring can be obtained from the Occupational Health Services section of OSH.

BIOLOGICAL EXPOSURE INDICES

Exposure	Determinant	Sampling Time	BEI
Acetone (2001)	Acetone in urine	End of shift	50mg/lL
Arsenic	Sum of inorganic arsenic metabolites	End of shift at end or work week	100µg/L
Cadmium (2001)	Cadmium in blood Cadmium in urine	Not critical Not critical	0.044µmol/L (5µg/L) 5 mmol/mol creatinine (5mg/g creatinine)
Carbon monoxide	Carboxyhaemoglobin in blood	End of shift	3.5% of haemoglobin
Chromium (VI) water-soluble fume	Chromium in urine	End of shift at end of work week	0.6µmol/L (30µg/litre)
Cobalt (2001)	Cobalt in urine	End of shift at end of work week	15µg/L
2-Ethoxyethanol and 2-Ethoxyethyl acetate	2-ethoxyacetic acid in urine	End of shift at end of work week	100mg/g creatinine
Fluorides	Fluoride in urine	Prior to shift End of shift	160µmol/L (3mg/L) 530µmol/L (10mg/L)
n-Hexane	2,5-hexanedione in urine	End of shift	5mg/L
Lead (inorganic)	Lead in blood Lead in urine	Not critical Not critical	See Appendix 4 0.72µmol/L (150µg/L)
Mercury	Mercury in urine	Not critical	0.25µmol/L (50µg/L)
Methyl alcohol	Methyl alcohol in urine	End of shift	15mg/L
Methyl ethyl ketone (MEK)	MEK in urine	End of shift	2mg/L

Exposure	Determinant	Sampling Time	BEI
Methyl isobutyl ketone (2001)	MIBK in urine	End of shift	2mg/L
Organophosphates	Cholinesterase activity in blood	**% of baseline**	**Recommended Action**
		Less than 60%	Suspend from working with pesticides which inhibit cholinesterase activity
		Less than 80%	Action level: repeat test to confirm result
		Greater than 75%	Permit a previously suspended worker to recommence normal duties
Pentachlorophenol (PCP)	Total PCP (including conjugates) in urine	Prior to last shift of week	1mg/L
Phenol (2001)	Total phenol in urine	End of shift	250mg/g creatinine
Sodium fluoroacetate (1080) (2001)	Sodium fluoroacetate in urine	End of shift	15µg/L
Styrene	Mandelic acid in urine	End of shift	1g/L
Trichloroethylene	Trichloacetic acid in urine	End or work week	100mg/L
Xylene	Methylhippuric acid in urine	End of shift	1.5g/L

Workplace Exposure Standards for Noise

The noise exposure standards are defined by Regulation 10 of the Health and Safety in Employment Regulations 1995.

Whether or not a person is wearing appropriate hearing protection, the following values of noise exposure are considered to be the limit for an acceptable risk to their hearing:

Exposure to levels of noise during any single day greater than:

(a) A noise exposure level, $L_{Aeq,\ 8h}$ of 85 dB(A); and

(b) A peak noise level, L_{peak} of 140 dB.

Noise exposure level, $L_{Eq,\ 8h}$ means the level of the daily noise exposure normalised to a nominal 8-hour working day, in dB(A) referenced to 20 micropascals. It is the steady noise level which would, in an 8-hour period, cause the same A-frequency-weighted sound energy as that due to the actual noise over the actual working day, and is the same as $L_{Aeq,\ 8h}$ in AS 1269.

Peak noise level L_{peak} means the highest frequency-unweighted peak sound pressure level in decibels referenced to 20 micropascals, measured using sound measuring equipment with "P" time-weighting, as specified in Australian Standard AS 1259.1 — *Sound Level Meters, Part 1: Non-integrating.*

Noise exposure $E_{A,T}$ in pascal-squared-hours (Pa^2h) is the time integral of squared instantaneous A-frequency weighted sound pressure over a particular time period, for example over a 24-hour period.

Examples of levels of noise exposure resulting in a noise exposure of 1 Pa^2h are listed in the table below:

$L_{Aeq,T}$ (dB(A))	Duration per Day (T)	$E_{A,T}$ (Pa^2h)
85 dBA	8 hours	1
88	4	1
91	2	1
94	1	1
97	30 min	1
100	15	1
102	8	1
106	4	1
109	2	1
115	30 secs	1

References

(1) Occupational Safety & Health Service, *Approved Code of Practice for the Management of Substances Hazardous to Health* (1997)

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(3) American Conference of Governmental Industrial Hygienists (ACGIH). *Threshold Limit Values and Biological Exposure Indices for 1993-1994*. ACGIH, Cincinnati, Ohio, (2000)*.

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(12) Lauwerys R.R and Hoet P. *Industrial Chemical Exposure, Guidelines for Biological Monitoring*. 2nd Ed. ISBN: 0-87371-650-7, (1993).

(13) American Conference of Governmental Industrial Hygienists. Guide to Occupational Exposure Values 2001, ACGIH Cincinnatti, Ohio, (2001)*

(14) Health and Safety Executive (UK). Occupational Exposure Limits 2000 , Guidance Note EH40/2000

(15) Health and Safety Executive (UK). *Rubber Fume in Air, Measured as Total Particulates and Cyclohexane Soluble Material*. MDHS 47.

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