Government of **Western Australia**
Department of **Mines, Industry Regulation and Safety**

Adjustment of atmospheric contaminant exposure standards – guide

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Introduction

Exposure standards represent the airborne concentration of a particular substance or mixture that must not be exceeded to protect the health of workers. They are based on the airborne concentrations of individual substances which, according to current knowledge, should not cause adverse health effects nor undue discomfort to nearly all workers.

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

Deviations from this traditional shift pattern are now the norm within the mining industry, and the potential for increased periods of contaminant exposure needs to be addressed through appropriate adjustment of 8-hour time-weighted exposure standards.

From trial and discussion there are four principal adjustment models that have emerged over time from the burgeoning number on offer:

- **Brief and Scala Model**: Accounts for increased exposure time and reduced recovery time, but does not consider the action of the agent within the body. This model is considered to be the most conservative of the four major models.
- **OSHA Model**: Categorises substances based on their toxic effect and assumes the magnitude of toxic response correlates to the concentration reaching the site of action of the agent.
- **Pharmacokinetic Model**: Uses a scientific, substance-specific methodology based around the concept of 'body burden'. The model is considered to be a relatively accurate method of exposure standard adjustment, but involves complicated calculations and knowledge of biological half-lives.
- **Québec Model**: Developed from the OSHA model but attributed the most recent, available toxicological information to generate adjustment categories for specific contaminants. These categories further assign an adjustment type and associated reduction factor calculation.

Recommended exposure standard adjustment method

There is consensus that employees working in excess of 8-hours/day or 40-hours/week should be provided with at least an equivalent degree of protection to those employees working conventional work shifts. There is no national consensus however as to the preferred exposure standard adjustment method for persons employed in mining operations.

To provide current and relevant guidance to the mining industry for adjustment of exposure standards for extended work shifts, recommendations made by the Australian Institute of Occupational Hygienists (AIOH) have been adopted by the Department of Mines, Industry Regulation and Safety (the department), and use of the modified Québec Model endorsed.

The Québec Model, developed by the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST), is supported by a comprehensive technical guide and a selection tool to assist in determining the most appropriate adjustment categories. This tool and guidance material have been adapted by the AIOH to represent current Safe Work Australia exposure standards, promoting applicability, ease of use and a standardised approach for use across the mining industry in Western Australia.

This guide and its endorsement of the modified Québec Model for extended work shift exposure standard adjustment, supersedes the department's *Adjustment of exposure standards for extended workshifts – guideline* published in 1999. In that guideline the recommended adjustment matrix considered contaminant health effects and shift rostering, however it does not reflect current toxicological knowledge.

Exposure standard adjustment in the mining industry

Certain conditions of application are associated with use of the Québec Model as follows:

1. Short-term exposure limits (STELs) and peak limitations are not subject to the adjustment principle, only the 8-hour time-weighted averages (TWAs) are subject to this.
2. The 8-hour TWA adjustment process applies only to nominal schedules with shifts of no less than 4 hours and no more than 16 hours.
3. In no case can the adjusted exposure standard be greater than the 8-hour TWA.

Where extended work shifts operate within the Western Australian mining industry, the following strategy should be applied with regard to occupational exposure standards.

1. Implement an appropriate exposure standard reduction regime that is either in-line with the Québec model, or provides for a more conservative approach. Adjusted average exposure values generated via the Québec Model are not to be exceeded.
2. Pursue the as low as reasonably practicable (ALARP) principle – industry should ensure that worker exposure to atmospheric contaminants is reduced as far as practicable below occupational exposure standards.
3. Adopt internal management action levels at some percentage of the exposure standard (≤ 50%) to trigger investigation and remedial action, if necessary.
4. Incorporate the chosen exposure standard adjustment methodology into the operation's health and hygiene management plan (HHMP).

The Québec Model adjustment regime is outlined in Appendix 1, and a link is provided to the AIOH adapted version of the Québec Model adjustment calculator (i.e. WES adjustment tool for extended shifts) in *Further guidance*.

Further guidance

- **Australian Institute of Occupational Hygienists (AIOH)**

  Adjustment of workplace exposure standards for extended work shifts: Position paper, 2nd edition, www.aioh.org.au/static/uploads/files/adjustment-of-workplace-exposure-standards-for-extended-work-shifts-wfvuzaencbed.pdf

- **Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST)**

  Guide for the adjustment of permissible exposure values (PEVs) for unusual work schedules: Technical guide T-22, 4th edition, www.irsst.qc.ca/media/documents/pubirsst/t-22.pdf

- **Safe Work Australia**

  Guidance on the interpretation of workplace exposure standards for airborne contaminants, www.safeworkaustralia.gov.au/doc/guidance-interpretation-workplace-exposure-standards-airborne-contaminants

- **Department of Mines, Industry Regulation and Safety**

  Preparation of a health and hygiene management plan – guide, www.dmp.wa.gov.au/Documents/Safety/MSH_G_HHMP.pdf

Appendix 1 Québec Model adjustment regime

Figure 1 charts the process of calculating the exposure standards for extended work shifts using the modified Québec Model adjustment regime. Supporting material to assist in the exposure standard calculations are provided in tables 1 to 4, which are from the IRSST's *Guide for the adjustment of permissible exposure values (PEVs) for unusual work schedules: Technical guide T-22, 4th edition ('IRSST guide')*.

A software package (i.e. WES adjustment tool for extended shifts) is available from the AIOH to assist in the calculations.

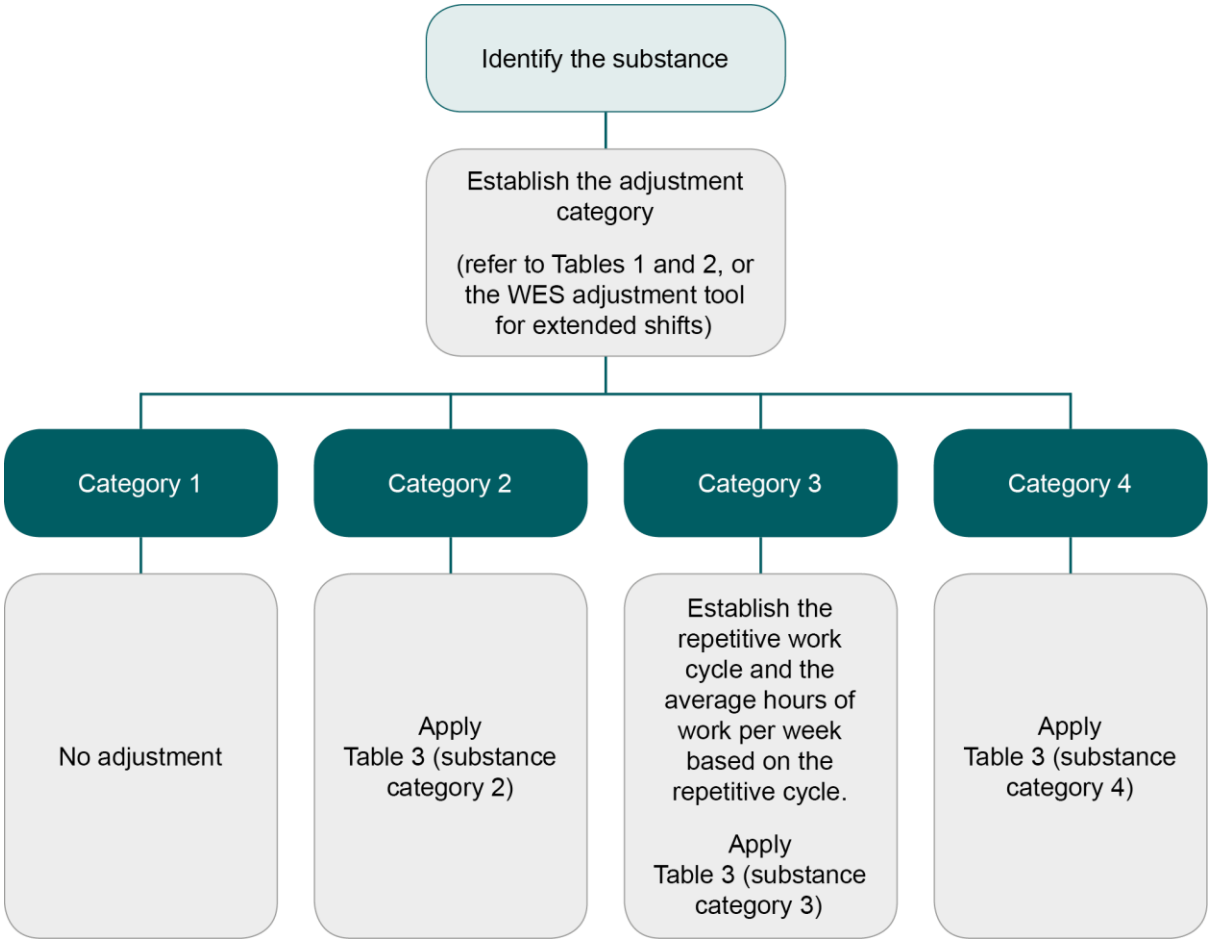

Figure 1 Exposure standard adjustment process (modified from IRSST guide)

Table 1 Adjustment categories (predominantly from IRSST guide)

Acetaldehyde	1A
Acetic acid	1B
Acetic anhydride	1B
Acetone	1C
Acetone cyanohydrin	1A
Acetonitrile	2
Acetophenone	1B
Acetylene	1C
Acetylsalicylic acid (Aspirin)	2
Acrolein	1B
Acrylamide	3
Acrylic acid	1B
Acrylonitrile	3
Adipic acid	3
Adiponitrile	4
Aldrin	4
Allyl alcohol	1B
Allyl glycidyl ether (AGE)	1B
Allyl propyl disulfide	1B
Aluminum [7429-90-5], (as Al), Alkyls (NOC)	1B
Aluminum (as Al), Metal	1C
Aluminum [7429-90-5], (as Al), Pyrotechnical powders	1C
Aluminum [7429-90-5], (as Al), Soluble salts	1B
Aluminum [7429-90-5], (as Al), Welding fumes	1C
Aluminum oxide (as Al), Td	1C
4-Aminodiphenyl	3
2-Aminoethanol	3
2-Aminopyridine	2
Amitrole	3
Ammonia	1B
Ammonium chloride fume	1B
Ammonium perfluorooctanoate	3
Ammonium sulfamate	1B
Aniline	1C
o-Anisidine	2
p-Anisidine	2
Antimony [7440-36-0], metal and compounds (as Sb)	3
Antimony trioxide (as Sb)	3
Antimony trioxide, production (as Sb)	3
ANTU (alpha-Naphthylthiourea)	2
Argon	1C
Arsenic, elemental [7440-38-2], and inorganic compounds (except Arsine) (as As)	3
Arsenic trioxide, production	3
Arsine	4
Asbestos, Actinolite	3
Asbestos, Amosite	3
Asbestos, Anthophyllite	3
Asbestos, Chrysotile	3
Asbestos, Crocidolite	3
Asbestos, Tremolite	3
Asphalt (petroleum) fumes	3
Atrazine	2
Azinphos-methyl	4
Barium, soluble compounds (as Ba)	2
Barium sulfate, Td	3
Barium sulfate, Rd	3
Benomyl	1C
Benz(a)anthracene	3
Benzene	3
Benzidine (production)	3

Benzo(a)pyrene	3
Benzo(b)fluoranthene	3
p-Benzoquinone	1B
Benzoyl peroxide	1B
Benzyl chloride	4
Beryllium [7440-41-7], metal and compounds (as Be)	3
Biphenyl	1B
Bismuth telluride (as Bi2Te3), Se-doped	3
Bismuth telluride (as Bi2Te3), Undoped	1C
Boron oxide	1B
Boron tribromide	1A
Boron trifluoride	1A
Bromacil	3
Bromine	1B
Bromine pentafluoride	1B
Bromoform	4
Bromotrifluoromethane	1C
1,3-Butadiene	3
Butane	1C
2-Butoxyethanol	3
n-Butyl acetate	1B
sec-Butyl acetate	1B
tert-Butyl acetate	1B
n-Butyl acrylate	1B
n-Butyl alcohol	1A
sec-Butyl alcohol	2
tert-Butyl alcohol	2
tert-Butyl chromate (as CrO3)	1A
n-Butyl glycidyl ether (BGE)	3
n-Butyl lactate	1B
Butyl mercaptan	1B

n-Butylamine	1A
o-sec-Butylphenol	1B
p-tert-Butyltoluene	3
Cadmium elemental and compounds (as Cd)	3
Calcium carbonate, Td	1C
Calcium chromate (as Cr)	3
Calcium cyanamide	1B
Calcium hydroxide	1B
Calcium oxide	1B
Calcium silicate (synthetic), Td	1C
Calcium sulfate, Td	1C
Calcium sulfate, Rd	1C
Camphor (synthetic)	1B
Caprolactam, Dust	1B
Caprolactam, Vapour	1B
Captafol	3
Captan	3
Carbaryl	4
Carbofuran	4
Carbon black	3
Carbon dioxide	1C
Carbon disulfide	4
Carbon monoxide	4
Carbon tetrabromide	4
Carbon tetrachloride	4
Carbonyl fluoride	4
-3 Carene	1B
Catechol	4
Cellulose (paper fibres), Td	1C
Cesium hydroxide	1B
Chlordane	4
Chlorinated camphene	4

Chlorinated diphenyl oxide	3
Chlorine	1C
Chlorine dioxide	2
Chlorine trifluoride	1A
Chloroacetaldehyde	1A
Chloroacetone	1A
alpha-Chloroacetophenone	1B
Chloroacetyl chloride	1B
Chlorobenzene	4
o-Chlorobenzylidene malononitrile	1A
Chlorobromomethane	3
Chlorodifluoromethane	1C
Chlorodiphenyl (42% chlorine)	3
Chlorodiphenyl (54% chlorine)	3
Chloroform	4
Chloromethyl methyl ether	3
bis (Chloromethyl) ether	3
1-Chloro-1-nitropropane	2
Chloropentafluoroethane	1C
Chloropicrin	2
β-Chloroprene	4
3-Chloropropene	3
2-chloropropionic acid	3
o-Chlorostyrene	4
o-Chlorotoluene	1B
Chlorpyrifos	4
Chromite ore processing (chromate) (as Cr)	3
Chromium (metal)	3
Chromium (III) compounds (as Cr)	3
Chromium VI, water insoluble inorganic compounds (as Cr)	3
Chromium VI, water soluble inorganic compounds (as Cr)	3

Chromyl chloride	3
Chrysene	3
Clopidol	1C
Coal dust (less than 5% crystalline silica), Rd	3
Coal dust (more than 5% crystalline silica), Rd	3
Coal tar pitch volatiles, as benzene solubles	3
Cobalt, elemental and inorganic compounds (as Co)	3
Cobalt hydrocarbonyl (as Co)	2
Cobalt tetracarbonyl (as Co)	2
Copper [7440-50-8], Fume (as Cu)	2
Copper [7440-50-8], Dust and mists (as Cu)	1B
Corundum, Td	1C
Cotton dust, cotton waste processing operation of waste recycling and garnetting	3
Cotton dust, in yarn manufacturing and cotton washing operations	3
Cotton dust, in textile mill waste house operations or in yarn manufacturing to dust from "lower-grade washed cotton"	3
Cotton dust, in textile slashing and weaving operations	3
Cresol (all isomers)	1B
Crotonaldehyde	1B
Crufomate	4
Cumene	2
Cyanamide	1B
Cyanides (as Cn)	1A
Cyanogen	1B
Cyanogen chloride	1A
Cyclohexane	1B
Cyclohexanol	4

Cyclohexanone	3
Cyclohexene	1B
Cyclohexylamine	1B
Cyclonite	3
Cyclopentadiene	1B
Cyclopentane	4
Cyhexatin	1C
2,4-D	3
DDT (Dichlorodiphenyltrichloroethane)	4
Decaborane	4
Demeton®	4
Di-sec-octyl phthalate	3
2,6-Di-tert-butyl-p-cresol	1C
Diacetone alcohol	1B
1,6-Diaminohexane	1B
Diazinon®	4
Diazomethane	4
Diborane	4
1,2-Dibromoethane	3
Dibutyl phenyl phosphate	4
Dibutyl phosphate	1B
Dibutyl phthalate	1B
2-N-Dibutylaminoethanol	3
1,3-Dichloro -5,5-dimethyl hydantoin	1B
Dichloroacetylene	1A
o-Dichlorobenzene	1A
p-Dichlorobenzene	3
3,3'-Dichlorobenzidine	3
1,4-Dichloro-2-butene	3
Dichlorodifluoromethane	1C
1,1-Dichloroethane	4
1,2-Dichloroethane	3
Dichloroethyl ether	2

1,1-Dichloroethylene	3
1,2-Dichloroethylene	4
Dichlorofluoromethane	4
1,1-Dichloro-1-nitroethane	2
1,2-Dichloropropane	4
Dichloropropene (cis and trans)	4
2,2-Dichloropropionic acid	1B
1,2 Dichloro-1,1,2,2- tetrafluoroethane	1C
Dichlorvos	4
Dicrotophos	4
Dicyclopentadiene	3
Dicyclopentadienyl iron	1C
Dieldrin	4
Diethanolamine	1B
Diethyl ether	1B
Diethyl ketone	2
Diethyl phthalate	3
Diethylamine	1B
2-Diethylaminoethanol	1B
Diethylene triamine	3
Difluorodibromomethane	4
Diglycidyl ether (DGE)	3
Diisobutyl ketone	1B
Diisopropyl ether	1B
Diisopropylamine	1B
Dimethyl carbamoyl chloride	3
Dimethyl sulfate	3
N,N-Dimethylacetamide	4
Dimethylamine	1B
N,N-Dimethylaniline	4
N,N-Dimethylformamide	3
1,1-Dimethylhydrazine	3
Dimethylphthalate	1B

Dinitolmide	3
Dinitro-ortho-cresol	3
Dinitrobenzene (all isomers)	4
Dinitrotoluene	4
Dioxane	3
Dioxathion	3
Diphenylamine	4
Dipropylene glycol monomethyl ether	2
Diquat, Td	3
Diquat, Rd	3
Disulfiram	2
Disulfoton	4
Diuron	1C
Divinyl benzene	1B
Emery, Td	1C
Endosulfan	4
Endrin	2
Enflurane	2
Epichlorohydrin	4
EPN	4
Ethane	1C
Ethion	4
2-Ethoxyethanol (EGEE)	4
2-Ethoxyethyl acetate (EGEEA)	4
Ethyl acetate	1B
Ethyl acrylate	3
Ethyl alcohol	1B
Ethyl amyl ketone	1B
Ethyl benzene	3
Ethyl bromide	4
Ethyl butyl ketone	2
Ethyl chloride	4
Ethyl formate	1B

Ethyl mercaptan	1B
Ethyl silicate	3
Ethylamine	1B
Ethylene	1C
Ethylene chlorohydrin	1A
Ethylene glycol (vapour and mist)	1A
Ethylene glycol dinitrate	1A
Ethylene imine	4
Ethylene oxide	3
Ethylenediamine	3
Ethylidene norbornene	1A
N-Ethylmorpholine	2
Fenamiphos	4
Fensulfothion	4
Fenthion	4
Ferbam	1B
Ferrovanadium (dust)	1B
Fibres, Artificial Vitreous Mineral Fibres, Fibrous glass, continuous filament, Td	1C
Fibres, Artificial Vitreous Mineral Fibres, Fibrous glass, microfibres	3
Fibres, Artificial Vitreous Mineral Fibres, Insulation wool fibres, Glass wool	1B
Fibres, Artificial Vitreous Mineral Fibres, Insulation wool fibres, Rock wool	1B
Fibres, Artificial Vitreous Mineral Fibres, Insulation wool fibres, Slag wool	1B
Fibres, Artificial Vitreous Mineral Fibres, Refractory fibres (ceramic or others)	3
Fibres, Natural Mineral Fibres, Attapulgite	3
Fibres, Natural Mineral Fibres, Erionite	1A

Fibres-Natural Mineral Fibres, Wollastonite, Td	1B
Fibres-Natural Mineral Fibres, Wollastonite, Rd	1B
Fibres, Organic Synthetic Fibres, Carbon and graphite fibres, Td	3
Fibres, Organic Synthetic Fibres, Carbon and graphite fibres, Rd	3
Fibres, Organic Synthetic Fibres, Para-aramide fibres (Kevlar®, Twaron®)	3
Fibres, Organic Synthetic Fibres, Polyolefin fibres, Td	1C
Fluorides (as F)	3
Fluorine	1B
Fonofos	4
Formaldehyde	1A
Formamide	3
Formic acid	1B
Furfural	1B
Furfuryl alcohol	1B
Gasoline	2
Germanium tetrahydride	2
Glutaraldehyde	1A
Glycerin (mist)	1C
Glycidol	1B
Grain dust (oat, wheat, barley), Td	4
Graphite (all forms except fibres), Rd	3
Gypsum, Td	1C
Gypsum, Rd	1C
Hafnium	3
Halothane	4
Helium	1C
Heptachlor	4
Heptachlore epoxide	3
n-Heptane	2

Hexachlorobenzene	3
Hexachlorobutadiene	3
Hexachlorocyclopentadiene	4
Hexachloroethane	3
Hexachloronaphthalene	3
Hexafluoroacetone	4
Hexamethyl phosphoramide	3
Hexamethylene diisocyanate	3
n-Hexane	4
Hexane (other isomers)	1C
sec-Hexyl acetate	1B
Hexylene glycol	1A
Hydrazine	3
Hydrogen	1C
Hydrogen bromide	1A
Hydrogen chloride	1A
Hydrogen cyanide	1A
Hydrogen fluoride (as F)	1A
Hydrogen peroxide	1B
Hydrogen selenide (as Se)	4
Hydrogen sulfide	1C
Hydrogenated terphenyls	3
Hydroquinone	4
2-Hydroxypropyl acrylate	1B
Indene	1B
Indium [7440-74-6] and compounds (as In)	4
Inhalable dust*	3
Iodine	1A
Iodoform	2
Iron pentacarbonyl (as Fe)	2
Iron salts, soluble (as Fe)	1B
Iron trioxide, dust and fume (as Fe)	3

Isoamyl alcohol	2
Isobutyl acetate	1B
Isobutyl alcohol	1B
Isocyanate oligomers	3
Isooctyl alcohol	2
Isophorone	1A
Isophorone diisocyanate	3
Isopropoxyethanol	3
Isopropyl acetate	1B
Isopropyl alcohol	2
Isopropyl glycidyl ether (IGE)	3
Isopropylamine	1B
N-Isopropylaniline	2
Kaolin, Rd	3
Ketene	2
L.P.G. (Liquified petroleum gas)	1C
Lead and inorganic compounds	3
Lead arsenate (as Pb3(AsO4)2)	4
Lead chromate (as Cr)	3
Lead tetraethyl (as Pb)	3
Lead tetramethyl (as Pb)	3
Limestone, Td	1C
Lindane	4
Lithium hydride	1B
Magnesite, Td	1C
Magnesium oxide fume (as Mg)	2
Malathion	4
Maleic anhydride	4
Manganese, Fume, dust and compounds (as Mn), Td	4
Manganese cyclopentadienyl tricarbonyl (as Mn)	4
Manganese methyl cyclopentadienyl tricarbonyl (as Mn)	4
Manganese tetroxide	3
Mercury [7439-97-6], Alkyl compounds (as Hg)	4
Mercury [7439-97-6], aryl compounds	3
Mercury [7439-97-6], inorganic compounds (as Hg)	3
Mercury [7439-97-6], mecury vapour (as Hg)	3
Mesityl oxide	1B
Methacrylic acid	1B
Methane	1C
Methomyl	4
Methoxychlor	4
2-Methoxyethanol (EGME)	4
2-Methoxyethyl acetate (EGMEA)	4
4-Methoxyphenol	1B
Methyl acetate	2
Methyl acetylene	1C
Methyl acetylene-propadiene mixture (MAPP)	1C
Methyl acrylate	3
Methyl alcohol	4
Methyl amyl alcohol	1B
Methyl n-amyl ketone	1B
Methyl bromide	4
Methyl tert-butyl ether	4
Methyl n-butyl ketone	3
Methyl chloride	4
Methyl chloroform	2
Methyl 2-cyanoacrylate	3
Methyl demeton	4
Methyl ethyl ketone (MEK)	1B
Methyl ethyl ketone peroxide	1A
Methyl formate	1B
Methyl hydrazine	1A

Methyl iodide	4
Methyl isoamyl ketone	1B
Methyl isobutyl ketone	1B
Methyl isocyanate	3
Methyl isopropyl ketone	1B
Methyl mercaptan	1B
Methyl methacrylate (monomer)	1B
Methyl parathion	4
Methyl propyl ketone	2
Methyl silicate	2
alpha-Methyl styrene	2
Methylacrylonitrile	4
Methylal	1B
Methylamine	1B
N-Methylaniline	4
Methylcyclohexane	1B
Methylcyclohexanol	3
o-Methylcyclohexanone	1B
Methylene chloride	4
4,4'-Methylene bis (2-chloroaniline) (MOCA)	4
Methylene bis (4-cyclohexylisocyanate)	3
4,4'-Methylene dianiline	3
Methylene bis (4-phenyl isocyanate) (MDI)	3
Metribuzin	2
Mica, Rd	3
Mineral oil (mist)	3
Molybdenum [7439-98-7] (as Mo), Insoluble compounds	1C
Molybdenum [7439-98-7] (as Mo), Soluble compounds	1C
Monocrotophos	4
Morpholine	1B

Naled	4
Naphthalene	1B
β-Naphthylamine	3
Neon	1C
Nickel, Metal	3
Nickel [7440-02-0], Insoluble compounds (as Ni)	3
Nickel [7440-02-0], Soluble compounds (as Ni)	3
Nickel carbonyl (as Ni)	2
Nickel 13ulphide roasting, fume and dust (as Ni)	3
Nicotine	2
Nitrapyrin	1C
Nitric acid	2
p-Nitroaniline	4
Nitrobenzene	4
p-Nitrochlorobenzene	4
4-Nitrodiphenyl	3
Nitroethane	1B
Nitrogen	1C
Nitrogen dioxide	4
Nitrogen monoxide	2
Nitrogen trifluoride	2
Nitroglycerin (NG)	1A
Nitromethane	4
1-Nitropropane	3
2-Nitropropane	3
N-Nitrosodimethylamine	3
Nitrotoluene (all isomers)	2
Nitrous oxide	3
Nonane	2
Octachloronaphthalene	3
Octane	2

Osmium tetroxide (as Os)	1B
Oxalic acid	1B
Oxygen difluoride	1A
Ozone	1A
Paraffin wax, fume	1B
Paraquat, respirable particulates, Rd	3
Parathion	4
Particulates Not Otherwise Classified(PNOC)*, Td	3
Pentaborane	2
Pentachloronaphthalene	3
Pentachloronitrobenzene	3
Pentachlorophenol	3
Pentaerythritol	1C
n-Pentane	2
n-Amyl acetate	1B
sec-Amyl acetate	1B
tert-Amyl acetate	1B
Isoamyl acetate	1B
2-Methyl-1-butyl acetate	1B
3-Pentyl actetate	1B
Perchloroethylene	4
Perchloromethyl mercaptan	2
Perchloryl fluoride	4
Perfluoroisobutylene	1A
Perlite, Td	1C
Perlite, Rd	1C
Phenol	4
Phenothiazine	3
Phenyl ether, vapour	1B
Phenyl glycidyl ether (PGE)	3
Phenyl mercaptan	1B
meta-Phenylenediamine	3
ortho-Phenylenediamine	3
p-Phenylenediamine	3
Phenylhydrazine	3
n-Phenyl-ß-naphthylamine	3
Phenylphosphine	1A
Phorate	4
Phosdrin	4
Phosgene	2
Phosphine	2
Phosphoric acid	1B
Phosphorus (yellow)	1B
Phosphorus oxychloride	1B
Phosphorus pentachloride	1B
Phosphorus pentasulfide	1B
Phosphorus trichloride	1B
Phthalic anhydride	3
m-Phthalodinitrile	1C
Picloram	1C
Picric acid	3
Pindone	3
α-Pinene	1B
β-Pinene	1B
Piperazine dihydrochloride	3
Plaster of Paris, Td	1C
Plaster of Paris, Rd	1C
Platinum, Metal	3
Platinum [7440-06-4], Soluble salts (as	3
Polytetrafluoroethylene decomposition products	2
Portland cement, Td	1B
Portland cement, Rd	1B
Potassium hydroxide	1A
Propane	1C

Propane sultone	3
Propargyl alcohol	1B
β-Propiolactone	3
Propionic acid	1B
Propoxur (baygon)	4
n-Propyl acetate	1B
n-Propyl alcohol	1B
n-Propyl nitrate	2
Propylene	1C
Propylene glycol dinitrate	4
Propylene glycol monomethyl ether	4
Propylene imine	3
Propylene oxide	3
Pyrethrum	3
Pyridine	3
Respirable dust*	3
Resorcinol	2
Rhodium [7440-16-6], Metal and insoluble compounds (as Rh)	3
Rhodium [7440-16-6], Soluble compounds (as Rh)	3
Ronnel	4
Rosin core solder pyrolysis products (as Formaldehyde)	3
Rotenone	4
Rouge, Td	1C
Rubber solvent (Naphtha)	2
Selenium and compounds (as Se)	4
Selenium hexafluoride (as Se)	4
Sesone	3
Silica, Amorphous, Diatomaceous earth (uncalcined), Td	1C
Silica - Amorphous, fumes, Rd	3
Silica, Amorphous, fused, Rd	3
Silica, Amorphous, gel, Rd	1C

Silica, Amorphous, precipitated, Td	1C
Silica, Crystalline, Cristobalite, Rd	3
Silica, Crystalline, Quartz, Rd	3
Silica, Crystalline, Tridymite, Rd	3
Silica, Crystalline, Tripoli, Rd	3
Silicon, Td	1C
Silicon carbide (non- fibrous), Td	1C
Silicon tetrahydride	2
Silver, Metal	3
Silver [7440-22-4], Soluble com pounds (as Ag)	3
Soapstone, Td	3
Soapstone, Rd	3
Sodium azide	1A
Sodium bisulfite	1B
Sodium fluoroacetate	2
Sodium hydroxide	1A
Sodium metabisulfite	1B
Borates, tetra, sodium salt , Anhydrous	1B
Borates, tetra, sodium salt , Decahydrate	1B
Borates, tetra, sodium salt , Pentahydrate	1B
Starch, Td	3
Stibine (as Sb)	4
Stoddard solvent	4
Strontium chromate (as Cr)	3
Strychnine	2
Styrene (monomer)	4
Subtilisins (Proteolytic enzymes as 100 % pure crystalline enzyme)	1C
Succinaldehyde	1B
Sucrose	1C
Sulfometuron methyl	3

Sulfotep	4
Sulfur dioxide	1B
Sulfur hexafluoride	1C
Sulfur monochloride	1A
Sulfur pentafluoride	1A
Sulfur tetrafluoride	1A
Sulfuric acid	1B
Sulfuryl fluoride	3
Sulprofos	4
2,4,5-T	1C
Talc, fibrous	3
Talc, non-fibrous, Rd	3
Tantalum [7440-25-7], metal and oxide dusts (as Ta)	1C
Tellurium and compounds (as Te)	4
Tellurium hexafluoride (as Te)	2
Temephos	4
TEPP	4
Terephthalic acid	1C
Terphenyls	1A
1,1,2,2-Tetrabromoethane	4
1,1,1,2-Tetrachloro-2,2-difluoroethane	4
1,1,2,2-Tetrachloro-1, 2-difluoroethane	4
1,1,2,2-Tetrachloroethane	4
Tetrachloronaphthalene	3
Tetrahydrofuran	1B
Tetramethyl succinonitrile	2
Tetranitromethane	4
Tetrasodium pyrophosphate	1B
Tetryl	3
Thallium, elemental [7440-28-0], and soluble compounds (as Tl)	3
4,4'-Thiobis (6-tert-butyl-m-cresol)	1C

Thioglycolic acid	1B
Thionyl chloride	1A
Thiram®	3
Tin, Metal	3
Tin [7440-31-5], Organic compounds (as Sn)	3
Tin [7440-31-5], Oxide and inorganic compounds, except SnH4 (as Sn)	3
Titanium dioxide, Td	1C
o-Tolidine	3
Toluene	4
Toluene diisocyanate (TDI) (isomers mixture)	3
o-Toluidine	4
m-Toluidine	2
p-Toluidine	4
Tributyl phosphate	1B
Trichloroacetic acid	1B
1,2,4-Trichlorobenzene	1B
1,1,2-Trichloroethane	4
Trichloroethylene	2
Trichlorofluoromethane	1A
Trichloronaphthalene	3
1,2,3-Trichloropropane	3
1,1,2-Trichloro-1,2,2-trifluoroethane	2
Tri-o-cresyl phosphate	3
Triethanolamine	3
Triethylamine	4
Triglycidyl isocyanurate (TGIC) (alpha-)	3
Triglycidyl isocyanurate (TGIC) (beta)	3
Triglycidyl isocyanurate (TGIC) (mixed isomers)	3
Trimellitic anhydride	3
Trimethyl benzene	3

Trimethyl phosphite	1B
Trimethylamine	1B
2,4,6-Trinitrotoluene (TNT)	3
Triphenyl amine	1C
Triphenyl phosphate	4
Tungsten [7440-33-7] (as W) , Insoluble compounds	1C
Tungsten [7440-33-7] (as W) , Soluble compounds	2
Turpentine	1B
Uranium [7440-61-1] (natural) , Insoluble compounds (as U)	3
Uranium (natural) [7440-61-1], Soluble compounds (as U)	3
n-Valeraldehyde	1B
Vanadium pentoxide, fume and respirable dust (as V2O5)	1B
Vegetable oil mists (except castor, cashew and other similar irritant oils)	1C
Vinyl acetate	1B
Vinyl bromide	3
Vinyl chloride (monomer)	3

Vinyl cyclohexene dioxide	3
Vinyl toluene	1B
VM&P Naphtha	1B
Warfarin	4
Welding fumes (not otherwise classified)	2
Wood dust (western red cedar), Td	3
Wood dust hard and soft, except red cedar, Td	3
Xylene (o-,m-,p- isomers)	2
m-Xylene-alpha, alpha'-diamine	1A
Xylidine (mixed isomers)	3
Yttrium [7440-65-5], metal and compounds (as Y)	3
Zinc chloride, fume	2
Zinc chromates [13530-65-9;11103-86-9; 37300-23-5] (as Cr)	3
Zinc stearate	1C
Zinc, oxide, Dust, Td	1C
Zinc, oxide, Fume	2
Zirconium [7440-67-7] and compounds (as Zr)	1C

**Note: Adjustment categories for Inhalable dust, Respirable dust and Particulates Not Otherwise Classified (PNOC), have been updated to reflect an adjustment based on potential health effects following long-term exposure.*

Table 2 List of adjustment categories (from IRSST guide)

	Adjustment classification	Type of adjustment
1A	Substances regulated by a ceiling (peak) value	NO adjustment
1B	Irritating or malodorous substances	
1C	Simple asphyxiants, substances presenting a safety risk or a very low health risk, whose half-life is less than 4 hours	
2	Substances that produce effects following short-term exposure	DAILY adjustment
3	Substances that produce effects following long-term exposure	WEEKLY adjustment
4	Substances that produce effects following a short- or long-term exposure	DAILY or WEEKLY adjustment – the most conservative of the two.

Table 3 Calculating the adjustment factors (modified from IRSST guide)

Substance category	Adjustment factor exposure calculation
1	No adjustment factor
2	$Fa = \frac{8}{Hd}$, or refer to Table 4
3	$Fa = \frac{40}{Hwk}$, or refer to Table 4
4	$Fa = \frac{8}{Hd}$ and $\frac{40}{Hwk}$, or refer to Table 4. Apply the lowest adjustment factor of the two

Fa = adjustment factor Hd = exposure duration in hours per shift

Hwk = average duration of work shifts per week based on a repetitive work cycle[1]

[1] ***Repetitive work cycle***: calendar period during which the work schedule (work shift) is exactly repeated on a daily and weekly basis. For example, a conventional schedule of 8-hour/day (Monday to Friday) and 5-day/week is a *repetitive calendar-week work cycle.* A schedule of 10-hour/day (Tuesday to Friday) is also a *repetitive calendar-week work cycle.* However, a schedule of 12-hour/day for 7 consecutive days, followed by 7 days off, would be a 14-day *repetitive cycle*. If this same schedule consists of alternating weeks of day and night shifts, it would then be a 28-day repetitive cycle.

Table 4 Category 2 and 3 adjustments (from IRSST guide)

Category 2		Category 3	
h/day	Fa	h/wk	Fa
8.0	1.00	**40**	1.00
8.5	0.94	**41**	0.98
9.0	0.89	**42**	0.95
9.5	0.84	**43**	0.93
10.0	0.80	**44**	0.91
10.5	0.76	**45**	0.89
11.0	0.73	**46**	0.87
11.5	0.70	**47**	0.85
12.0	0.67	**48**	0.83
12.5	0.64	**49**	0.82
13.0	0.62	**50**	0.80
13.5	0.59	**51**	0.78
14.0	0.57	**52**	0.77
14.5	0.55	**53**	0.75
15.0	0.53	**54**	0.74
15.5	0.52	**55**	0.73
16.0	0.50	**56**	0.71

Fa = adjustment factor