Health and Safety
Executive

EH40/2005 Workplace exposure limits

Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended)


EH40/2005 Workplace exposure limits

This is a free-to-download, web-friendly version of EH40/2005 (First edition, published 2005). This version has been adapted for online use from HSE's current printed version.

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This latest version of EH40 reflects the introduction of a new framework for adequate control of exposure to hazardous substances. The new workplace exposure limits (WELs) replace the previous system of MELs (maximum exposure limits) and OESs (occupational exposure standards). It is felt this will be a more effective method of occupational exposure limit.

This book contains the new WELs, as set by the Health and Safety Commission, and will guide those responsible for controlling exposure to hazardous substances at work.

Addendum to EH40 2005

This addendum has been produced because in July 2006 the Health and Safety Commission agreed to revise the Workplace Exposure Limit (WEL) for respirable crystalline silica from 0.3 to 0.1 and note that this is being kept under review.

Page 27: entry for Silica, respirable crystalline, change to:
'see page 31 - 0.1 - - HSC/E plans to keep this limit value under review'

The additional changes listed below are for further clarification to certain entries in EH40 2005:

Page 17: entry for Cyanides, except HCN, cyanogen and cyanogen chloride:
Add words '(as Cn)' at end.

Page 23: entry for Manganese and its inorganic compounds:
Add words '(as Mn)' at end.

Page 28: entry for Tetracarbonylnickel: Add words '(as Ni)' at end.

Page 31: Insert new entry in Table 2:

'Isocyanate 1µmol urinary diamine/mol creatinine in urine Post task'

Page 56: under entry for Cycloalkanes replace '1200 mg.m^{-3}' with 800 mg.m^{-3}'.

HSE Books

Supplement to EH40/2005

New and revised WELs in force from October 2007

On 1 October 2007, the European Commission’s 2nd Directive on Indicative Occupational Exposure Limit Values (2006/15/EC) will be implemented in Great Britain and Northern Ireland.

This directive requires Member States of the European Union to introduce domestic occupational exposure limits for the substances listed in the Annex to the directive. Additionally, the level of the domestic limit must take account of the Indicative Occupational Exposure Limit Value (IOELV).

The Health and Safety Commission has approved new and revised Workplace Exposure limits (WELs) required to implement the 2nd IOELV Directive and the attached table gives details of the changes that will come into force on 1 October 2007.

The changes can be summarised as follows:

- There are new entries for the following substances, for which there is currently no WEL: 2(2-Butoxyethoxy) ethanol, Isopentane, 2-(2-Methoxyethoxy) ethanol, Neopentane, Pentane, pyrethrum (purified of sensitising lactones).
- There are new 8-hour TWA WELs for Diphosphorus pentoxide and Phosphine and a new short-term exposure limit (STEL) for Phosphorus pentachloride.
- The entry for Pyrethins (ISO) is removed.
- The following substances have amended WELs (either 8-hour TWA or STEL or both): 2-Aminoethanol, Bromine, Chlorine, Cyanamide, Diethylamine, Diphosphorus, pentasulphide, Morpholine, Nitric acid, Nitrobenzene, Phosphine, Toluene.
- The existing 8-hour TWA WELs for Chlorine and Nitric acid and the existing short-term exposure limit (STEL) for Nitrobenzene are withdrawn.
- A ‘Skin’ notation is added for the following substances: 2-Aminoethanol, Cyanamide, Resorcinol.

Changes to the list of workplace exposure limits in EH40

1 New entries

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15 minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
2-(2 Botoxyethoxy) ethanol	112-34-5	10	67.5	15	101.2	R36
Isopentane	78-78-4	600	1800	-	-	R12, 51/53, 65, 66, 67
2-(2-Methoxyethoxy) ethanol	111-77-3	10	50.1	-	-	Sk R63
Neopentane	463-82-1	600	1800	-	-	R12, 51/53

1 New entries continued

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15 minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Pentane	109-66-0	600	1800	-	-	R12, 51/53, 65, 66, 67
Pyrethrum (purified of sensitising lactones)	8003-34-7	-	1	-	-	

2 Removed entries

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15 minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Pyrethrins (ISO)	8003-34-7 121-21-1 121-29-9	-	5	-	10	R20/21/22, 50/53

3 Revised entries (changes in bold)

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15 minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
2-Aminoethanol	141-43-5	**1**	**2.5**	**3**	**7.6**	**Sk** R20/21/22, 34
Bromine	7726-95-6	0.1	0.66	**0.2**	**1.3**	R26, 35, 50
Chlorine	7782-50-5	**-**	**-**	**0.5**	**1.5**	R23, 36/37/38, 50
Cyanamide	420-04-2	**0.58**	**1**	-	-	**Sk** R21, 25, 36/38, 43
Diethylamine	109-89-7	**5**	**15**	**10**	**30**	R11, 20/21/22, 35

3 Revised entries (changes in bold) ***continued***

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15 minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Diphosphorus pentasulphide	1314-80-3	-	1	-	**2**	R11, 20/22, 29, 50
Diphosphorus pentoxide	1314-56-3	-	**1**	-	2	R35
Morpholine	110-91-8	**10**	**36**	**20**	**72**	Sk R10, 20/21/22, 34
Nitric acid	7697-37-2	**-**	**-**	**1**	**2.6**	R8, 35
Nitrobenzene	98-95-3	**0.2**	**1**	**-**	**-**	Sk R23/24/25, 40, 48/23/24, 62, 51/53
Phosphine	7803-51-2	**0.1**	**0.14**	**0.2**	**0.28**	R12, 17, 26, 34, 50
Phosphorus pentachloride	10026-13-8	0.1	0.87	**0.2**	**2**	R14, 22, 26, 34, 48/20
Resorcinol	108-46-3	10	46	20	92	**Sk** R22, 36/38, 50
Toluene	108-88-3	50	191	**100**	**384**	Sk R11, 38, 48/20, 63, 65

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EH40/2005 contains material of different legal status.

Table 1 of EH40/2005 and the Notices of Approval have a special legal status as they are approved by the Health and Safety Commission. The Control of Substances Hazardous to Health Regulations 2002 impose requirements by reference to these sections, which are therefore legally binding. Thus, if Table 1 or the Notices of Approval apply to your work activities, health and safety inspectors will expect you to be complying with these requirements, and will if necessary take appropriate enforcement action.

The remainder of EH40/2005 is guidance. This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

Contents

Foreword

The new OEL framework

This edition of EH40 represents a new departure for the setting of, and compliance with, occupational exposure limits (OELs). The previous system, setting OELs as maximum exposure limits (MELs) and occupational exposure standards (OESs) has been discontinued in favour of a single type of OEL known as the workplace exposure limit or WEL.

MELs and OESs were introduced in 1989, when the first Control of Substances Hazardous to Health Regulations (COSHH) came into force. The Control of Substances Hazardous to Health (Amendment) Regulations 2004[1] removed the definitions of these two types of OEL and replaced them with the definition of a WEL. These changes came into effect on 6 April 2005.

The changes came about as a result of concerns expressed by the Health and Safety Commission's Advisory Committee on Toxic Substances (ACTS) about how well employers and other stakeholders understood OELs, and about how widely these were being used in industry. Research carried out for HSE showed that those concerns were justified. As a result, an ACTS Working Group was given the task of considering a new approach to the setting and use of OELs.

A discussion document published in March 2002 set out the concerns with the existing system and proposed options for a new system.

Following the comments received on this discussion document, a formal Consultative Document was published in October 2003, which made proposals for a new OEL framework. These proposals included the introduction of eight principles of good practice for the control of exposure to substances hazardous to health, and replacing MELs and OESs with WELs. Responses to this Consultative Document showed strong support for these proposals. Paragraphs 5 and 6 of this publication provide information on the principles of good practice and on how to apply WELs.

A further aspect of the new framework is that certain former OESs have not been converted to WELs because of doubts that the limit was not soundly-based. Those OESs, for which there was some concern that health was not adequately protected at the value of the OES, have been removed. Details of these substances can be found in a table on the HSE website (http://www.hse.gov.uk/aboutus/hsc/meetings/2004/091104/c06c.pdf). This table also provides advice on whether *COSHH essentials*[2] can be used to obtain advice on the control of these substances.

Although only the courts can give an authoritative interpretation of law, in considering the application of this guidance to people working under another's direction, the following should be considered. If people working under the control and direction of others are treated as self-employed for tax and national insurance purposes they may nevertheless be treated as their employees for health and safety purposes. It may therefore be necessary to take appropriate action to protect them. If any doubt exists about who is responsible for the health and safety of a worker this could be clarified and included in the terms of a contract. However, remember, a legal duty under section 3 of the Health and Safety at Work (HSW Act) cannot be passed on by means of a contract and there will still be duties towards others under section 3 of the HSW Act. If such workers are employed on the basis that they are responsible for their own health and safety, legal advice should be sought before doing so.

Introduction

1 Many people are exposed to a variety of substances at work (eg chemicals, fumes, dusts, fibres) which can, under some circumstances, have a harmful effect on their health. These are called ‘hazardous substances’. If exposure to a hazardous substance is not properly controlled it may cause ill health in a number of ways. The substance may cause harm by too much being taken into the body through breathing, by being absorbed through the skin, by being swallowed, or by acting directly on the body at the point of contact, eg the skin. Some illnesses caused by exposure to hazardous substances in the workplace (occupational diseases) may not appear until a long time after the first exposure. Therefore, it is important to know in advance how to protect the health of people working with hazardous substances and also of other people who may be affected by the work being carried out. WELs for hazardous substances at work are set by the Health and Safety Commission (HSC) on the recommendations of its Advisory Committee on Toxic Substances (ACTS) and published in EH40. A more detailed explanation is on pages 42-44.

What are WELs?

2 WELs are occupational exposure limits (OELs) set under COSHH,3 in order to help protect the health of workers. WELs are concentrations of hazardous substances in the air, averaged over a specified period of time referred to as a time-weighted average (TWA). Two time periods are used: long term (8 hours and short term (15 minutes). Short-term exposure limits (STELs) are set to help prevent effects, such as eye irritation, which may occur following exposure for a few minutes.

WELs and COSHH

3 The first requirement of COSHH is to prevent exposure to substances hazardous to health where it is ‘reasonably practicable’ (ie the costs in reducing exposure would not be grossly disproportionate to the benefits). This can be achieved by:

- changing the process so that the substance is no longer used/produced;
- replacing it with a safer alternative; or
- completely enclosing the process.

4 Regulation 7(7) of COSHH states that, ‘without prejudice to the requirement to prevent exposure, control of exposure to a substance hazardous to health shall only be treated as adequate if -

- (a) the principles of good practice for the control of exposure to substances hazardous to health set out in Schedule 2A are applied;
- (b) any workplace exposure limit approved for that substance is not exceeded; and
- (c) for a substance—
  - (i) which carries the risk phrase R45, R46 or R49, or for a substance or process which is listed in Schedule 1; or
  - (ii) which carries the risk phrase R42 or R42/43, or which is listed in section C of HSE publication *Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma*[4] as updated from time to time, or any other substance which the risk assessment has shown to be a potential cause of occupational asthma, exposure is reduced to as low a level as is reasonably practicable’.

Principles of good practice for the control of exposure to substances hazardous to health

5 The eight principles of good practice for the control of exposure to substances hazardous to health are set out in Schedule 2A of *The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance.*[5] The principles are reproduced below:

(a) design and operate processes and activities to minimise emission, release and spread of substances hazardous to health;
(b) take into account all relevant routes of exposure – inhalation, skin absorption and ingestion – when developing control measures;
(c) control exposure by measures that are proportionate to the health risk;
(d) choose the most effective and reliable control options which minimise the escape and spread of substances hazardous to health;
(e) where adequate control of exposure cannot be achieved by other means, provide, in combination with other control measures, suitable personal protective equipment;
(f) check and review regularly all elements of control measures for their continuing effectiveness;
(g) inform and train all employees on the hazards and risks from the substances with which they work and the use of control measures developed to minimise the risks;
(h) ensure that the introduction of control measures does not increase the overall risk to health and safety.

6 If employers apply the principles correctly, exposure should be below any relevant WEL. Control by personal protective equipment should only be used when other measures are not reasonably practicable. The list of WELs applies to concentrations of hazardous substances breathed in by the worker and are used to determine the adequacy of control measures. There are several publications which give advice and guidance on what is required under the COSHH Regulations. Some useful references are given on page 55.

Inhaled substances not assigned WELs

7 The absence of a substance from the list of WELs does not indicate that it is safe. For these substances, exposure should be controlled to a level to which nearly all the working population could be exposed, day after day at work, without adverse effects on health. As part of the assessment required under regulation 6 of COSHH, employers should determine their own working practices, and in-house standards for control. In some cases there may be sufficient information to set a self-imposed working standard, eg from manufacturers and suppliers of the substance, from publications of industry associations, occupational medicine and hygiene journals. Further information may be found in *Monitoring strategies for toxic substances*[6] and *COSHH essentials.*[2]

Employees and the self-employed

8 There are also some duties for employees and the self-employed under COSHH. Guidance is given in associated ACOPs, particularly the COSHH ACOP.[5] If a person working under an employer's control and direction is treated as self-employed for tax and national insurance purposes, they may nevertheless be an employee for health and safety purposes. You may need therefore to take appropriate action to protect them.

9 If you do not wish to employ workers on this basis, you should seek legal advice. Ultimately each case can only be decided on its own merits by a court of law.

Data Protection Act

10 Employers, in complying with the requirements of regulation 10 of COSHH, may decide to hold health surveillance records on their employees. The Data Protection Act[7] places requirements on those who hold personal data such as health surveillance records. Further information on the Act is available from the Office of the Information Commissioner (Tel: 01625 545745 Website: http://www.informationcommissioner.gov.uk/).

European occupational exposure limits

11 The exposure limits listed in Table 1 of this publication are all British limits, set under COSHH. In some cases, these also reflect a European limit applicable in all EU Member States. These limits were known originally as Indicative Limit Values (ILVs), and are currently called Indicative Occupational Exposure Limit Values (IOELVs).

12 IOELVs are health-based limits set under the Chemical Agents Directive (98/24/EC). The European Commission is advised on limits by its Scientific Committee on Occupational Exposure Limits (SCOEL). This committee evaluates the scientific information available on hazardous substances and makes recommendations for the establishment of an IOELV. IOELVs are listed in Directives, which Member States are obliged to implement by introducing national limits for the substances listed.

13 Only one IOELV Directive has so far been implemented, and the 63 limits arising from it are contained in Table 1.

14 Additionally, three limits in Table 1 derive from the Carcinogens Directive (2004/37/EC). These are the limits for benzene, hardwood dusts and vinyl chloride monomer, and are binding limits. Member States are obliged to implement binding limits exactly or to establish a national limit that is lower.

Further information and advice

15 Scientific and technical information for some of the substances listed in EH40 can be found in Toxicity Reviews, Criteria Documents and Risk Assessment Documents published by HSE and in the documents accompanying other nations' lists. [8-10] In addition, the scientific and technical basis for WELs set through the WATCH/ACTS process since the introduction of COSHH is published in EH64 *Summary criteria for occupational exposure limits.*[11] WELs that were established prior to the introduction of COSHH may not have an accompanying EH64 summary.

16 Further advice on occupational exposure limits and other aspects of occupational health and safety can be obtained from:

- HSE's Infoline: Tel 0845 345 0055 Fax: 02920 859260
  e-mail: hseinformationservices@natbrit.com
- the HSE website: www.hse.gov.uk
- HSE local offices - the telephone numbers are listed in the telephone directory under 'Health and Safety Executive'.

HSE publications are available from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA (Tel: 01787 881165, Fax: 01787 313995, Website: www.hsebooks.co.uk).

List of workplace exposure limits (WELs)

Annotations

BMGV Biological Monitoring Guidance Values are listed in Table 2.

Carc Capable of causing cancer and/or heritable genetic damage. The identified substances include those which:

- are assigned the risk phrases ‘R45: May cause cancer’; ‘R46: May cause heritable genetic damage’; ‘R49: May cause cancer by inhalation’ in the *Approved supply list*;[12] or
- a substance or process listed in Schedule 1 of COSHH.

Sen Capable of causing occupational asthma. The identified substances are those which:

- are assigned the risk phrase ‘R42: May cause sensitisation by inhalation’; or ‘R42/43: May cause sensitisation by inhalation and skin contact’ in the *Approved supply list*; or
- are listed in section C of HSE publication *Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma*[4] as updated from time to time, or any other substance which the risk assessment has shown to be a potential cause of occupational asthma.

Sk Can be absorbed through skin. The assigned substances are those for which there are concerns that dermal absorption will lead to systemic toxicity.

The system of nomenclature for the substances listed below is based, in the main, on the convention adopted by the International Union of Pure Applied Chemistry (IUPAC). Where this is not the case the substances will be flagged:

- **INN** International Non-proprietary Name;
- **ISO** International Organisation for Standardisation.

Notes

1 For the purposes of these limits, respirable dust and inhalable dust are those fractions of the airborne dust which will be collected when sampling is undertaken in accordance with the methods described in MDHS14/3 *General methods for sampling and gravimetric analysis of respirable and inhalable dust*,[13] as amended by the ISO/CEN convention.

2 Where no specific short-term exposure limit is listed, a figure three times the long-term exposure limit should be used.

3 The tables reproduce the R-phrases from the *Approved supply list*.[12]

4 Substances marked with an asterisk* indicate those for which classification and labelling was introduced in the 29th Adaptation to Technical Progress of the European Community’s Dangerous Substances Directive.

Risk phrases from the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 used in EH40

R2	Risk of explosion by shock, friction, fire or other sources of ignition
R4	Forms very sensitive explosive metallic compounds
R5	Heating may cause an explosion
R6	Explosive with or without contact with air
R7	May cause fire
R8	Contact with combustible material may cause fire
R10	Flammable
R11	Highly flammable
R12	Extremely flammable
R14	Reacts violently with water
R16	Explosive when mixed with oxidising substances
R17	Spontaneously flammable in air
R19	May form explosive peroxides
R20	Harmful by inhalation
R20/21	Harmful by inhalation and in contact with skin
R20/21/22	Harmful by inhalation, in contact with skin and if swallowed
R20/22	Harmful by inhalation and if swallowed
R21	Harmful in contact with skin
R21/22	Harmful in contact with skin and if swallowed
R22	Harmful if swallowed
R23	Toxic by inhalation
R23/24	Toxic by inhalation and in contact with skin
R23/25	Toxic by inhalation and if swallowed
R23/24/25	Toxic by inhalation, in contact with skin and if swallowed
R24	Toxic in contact with skin
R24/25	Toxic in contact with skin and if swallowed
R25	Toxic if swallowed
R26	Very toxic by inhalation
R26/27/28	Very toxic by inhalation, in contact with skin and if swallowed
R26/28	Very toxic by inhalation and if swallowed
R27	Very toxic in contact with skin
R27/28	Very toxic in contact with skin and if swallowed
R28	Very toxic if swallowed
R29	Contact with water liberates toxic gas
R31	Contact with acids liberates toxic gas
R32	Contact with acids liberates very toxic gas
R33	Danger of cumulative effects
R34	Causes burns
R35	Causes severe burns
R36	Irritating to eyes
R36/37	Irritating to eyes and respiratory system
R36/37/38	Irritating to eyes, respiratory system and skin
R36/38	Irritating to eyes and skin
R37	Irritating to respiratory system
R37/38	Irritating to respiratory system and skin
R38	Irritating to skin
R39	Danger of very serious irreversible effects
R39/23/24/25	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R40	Limited evidence of a carcinogenic effect
R41	Risk of serious damage to eyes
R42	May cause sensitisation by inhalation
R42/43	May cause sensitisation by inhalation and skin contact
R43	May cause sensitisation by skin contact
R44	Risk of explosion if heated under confinement

R45	May cause cancer
R46	May cause heritable genetic damage
R48	Danger of serious damage to health by prolonged exposure
R48/20	Harmful: danger of serious damage to health by prolonged exposure through inhalation
R48/20/21	Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/20/21/22	Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R48/20/22	Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/22	Harmful: danger of serious damage to health by prolonged exposure if swallowed
R48/23	Toxic: danger of serious damage to health by prolonged exposure through inhalation
R48/23/24	Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/23/25	Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/23/24/25	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R48/25	Toxic: danger of serious damage to health by prolonged exposure if swallowed
R49	May cause cancer by inhalation
R50	Very toxic to aquatic organisms
R50/53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R51	Toxic to aquatic organisms
R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R52/53	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R53	May cause long-term adverse effects in the aquatic environment
R59	Dangerous for the ozone layer
R60	May impair fertility
R61	May cause harm to the unborn child
R62	Possible risk of impaired fertility
R63	Possible risk of harm to the unborn child
R65	Harmful: may cause lung damage if swallowed
R66	Repeated exposure may cause skin dryness or cracking
R67	Vapours may cause drowsiness and dizziness
R68	Possible risk of irreversible effects

Table 1: List of approved workplace exposure limits

This list is legally binding, as it reproduces the list of workplace exposure limits (WELs) which have been approved by the Health and Safety Commission. The limits are given in ppm and mg.m^{-3}. The conversion method is given on page 42. The Control of Substances Hazardous to Health Regulations 2002 impose requirements by reference to this list.

However, the entries in the columns headed ‘CAS number’, and ‘Comments’ are not part of the approved list of WELs.The workplace exposure limits of the dusts included in the list below refer to the inhalable dust fraction, unless otherwise stated.

Table 1: List of approved workplace exposure limits

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Acetaldehyde	75-07-0	20	37	50	92	R12, 36/37, 40
Acetic anhydride	108-24-7	0.5	2.5	2	10	R10, 20/22, 34
Acetone	67-64-1	500	1210	1500	3620	R11 36, 66, 67
Acetonitrile	75-05-8	40	68	60	102	R11, 20/21/22, 36
o-Acetylsalicylic acid	50-78-2	-	5	-	-	
Acrylaldehyde (Acrolein)	107-02-8	0.1	0.23	0.3	0.7	R11 24/25, 26, 34, 50
Acrylamide	79-06-1	-	0.3	-	-	Carc Sk R45, 46, 20/21, 25, 36/38, 43, 48/23/24/25, 62
Acrylonitrile	107-13-1	2	4.4	-	-	Carc Sk R45, 11, 23/24/25, 37/38, 41, 43, 51/53* HSC/E plans to review the limit values for this substance
Allyl alcohol	107-18-6	2	4.8	4	9.7	Sk R10, 23/24/25, 36/37/38, 50
Aluminium alkyl compounds		-	2	-	-	R14, 17, 34
Aluminium metal	7429-90-5					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Aluminium oxides	1344-28-1					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Aluminium salts, soluble		-	2	-	-	
2-Aminoethanol	141-43-5	1	2.5	3	7.6	Sk R20/21/22, 34*
Ammonia, anhydrous	7664-41-7	25	18	35	25	R10, 23, 34, 50*
Ammonium chloride, fume	12125-02-9	-	10	-	20	R22, 36
Ammonium sulphamidate	7773-06-0	-	10	-	20	
Aniline	62-53-3	1	4	-	-	Sk R23/24/25, 40, 41 48/23/24/25, 68, 50*
Antimony and compounds except stibine (as Sb)		-	0.5	-	-	
p-Aramid respirable fibres	26125-61-1	0.5	fibres/ml	-	-	

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Arsenic and arsenic compounds except arsine (as As)		-	0.1	-	-	Carc HSC/E plans to review the limit values for this substance
Arsine	7784-42-1	0.05	0.16	-	-	R12, 26, 48/20, 50/53
Asphalt, petroleum fumes	8052-42-4	-	5	-	10	
Azodicarbonamide	123-77-3	-	1.0	-	3.0	Sen R42, 44
Barium compounds, soluble (as Ba)		-	0.5	-	-	
Barium sulphate	7727-43-7					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Benzene	71-43-2	1	-	-	-	Carc Sk R45, 46, 11, 36/38, 48/23/24/25, 65*
Benzyl butyl phthalate	85-68-7	-	5	-	-	R61, 62, 50/53*
Benzyl chloride	100-44-7	0.5	2.6	1.5	7.9	Carc R45, 22, 23, 37/38, 41, 48/22
Beryllium and beryllium compounds (as Be)		-	0.002	-	-	Carc
Bis(2-ethylhexyl) phthalate	117-81-7	-	5	-	10	R60, 61
Bis(chloromethyl) ether	542-88-1	0.001	0.005	-	-	Carc R45, 10, 22, 24, 26
Bornan-2-one	76-22-2	2	13	3	19	
Boron tribromide	10294-33-4	-	-	1	10	R14, 26/28, 35
Bromacil (ISO)	314-40-9	1	11	2	22	
Bromine	7726-95-6	0.1	0.66	0.2	1.3	R26, 35, 50
Bromomethane	74-83-9	5	20	15	59	Sk R23/25, 36/37/38, 48/20, 68, 50, 59
Butane	106-97-8	600	1450	750	1810	Carc (only applies if Butane contains more than 0.1% of buta-1, 3-diene) R12

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Buta-1,3-diene	106-99-0	10	22	-	-	Carc R45, 46, 12 HSC/E plans to review the limit values for this substance
Butan-1-ol	71-36-3	-	-	50	154	Sk R10, 22, 37/38, 41, 67
Butan-2-ol	78-92-2	100	308	150	462	R10, 36/37, 67
Butan-2-one (methyl ethyl ketone)	78-93-3	200	600	300	899	Sk BMGV R11, 36, 66, 67
2-Butoxyethanol	111-76-2	25	-	50	-	Sk BMGV R20/21/22, 36/38
2-Butoxyethyl acetate	112-07-2	20	-	50	-	Sk R20/21
n-Butyl acrylate	141-32-2	1	5	5	26	R10, 36/37/38, 43
n-Butyl chloroformate	592-34-7	1	5.7	-	-	R10, 23, 34
sec-Butyl acetate	105-46-4	200	966	250	1210	R11, 66
tert-Butyl acetate	540-88-5	200	966	250	1210	R11, 66
Butyl acetate	123-86-4	150	724	200	966	R10, 66, 67
Butyl lactate	138-22-7	5	30	-	-	
2-*sec*-Butylphenol	89-72-5	5	31	-	-	Sk
Cadmium & cadmium compunds except cadmium oxide fume cadmium sulphide & cadmium sulphide pigments (as Cd)		-	0.025	-	-	Carc (cadmium metal,* cadmium chloride, flouride and sulphate)
Cadmium oxide fume (as Cd)	1306-19-0	-	0.025	-	0.05	Carc R45, 26, 48/23/25, 62, 63, 68, 50/53*
Cadmium sulphide and cadmium sulphide pigments (respirable dust (as Cd)		-	0.03	-	-	Carc (cadmium sulphide*)
Caesium hydroxide	21351-79-1	-	2	-	-	
Calcium carbonate inhalable dust respirable	1317-65-3	 - -	 10 4	 - -	 - -	
Calcium cyanamide	156-62-7	-	0.5	-	1	R22, 37, 41

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Calcium hydroxide	1305-62-0	-	5	-	-	
Calcium oxide	1305-78-8	-	2	-	-	
Calcium silicate	1344-95-2					
inhalable dust		-	10	-	-	
respirable		-	4	-	-	
Captan (ISO)	133-06-2	-	5	-	15	R23, 40, 41, 43, 50
Carbon black	1333-86-4	-	3.5	-	7	
Carbon dioxide	124-38-9	5000	9150	15000	27400	
Carbon disulphide	75-15-0	10	32	-	-	Sk R11, 36/38, 48/23, 62, 63 HSC/E plans to review the limit values for this substance
Carbon monoxide	630-08-0	30	35	200	232	Bmgv R12, 23, 48/23, 61
Carbon tetrachloride	56-23-5	2	13	-	-	Sk R23/24/25, 40, 48/23, 52/53, 59*
Cellulose	9004-34-6					
inhalable dust		-	10	-	20	
respirable		-	4	-	-	
Chlorine	7782-50-5	-	-	0.5	1.5	R23, 36/37/38, 50
Chlorine dioxide	10049-04-4	0.1	0.28	0.3	0.84	R6, 8, 26, 34, 50*
Chloroacetaldehyde	107-20-0	-	-	1	3.3	R24/25, 26, 34, 40, 50*
2-Chloroacetophenone	532-27-4	0.05	0.32	-	-	
Chlorobenzene	108-90-7	1	-	3	-	Sk R10, 20, 51/53*
Chlorodifluoromethane	75-45-6	1000	3590	-	-	
Chloroethane	75-00-3	50	-	-	-	R12, 40, 52/53
2-Chloroethanol	107-07-3	-	-	1	3.4	Sk R26/27/28
1-Chloro-2,3-epoxypropane (Epichlorohydrin)	106-89-8	0.5	1.9	1.5	5.8	Carc R45, 10, 23/24/25, 34, 43
Chloroform	67-66-3	2	9.9	-	-	Sk R22, 38, 40, 48/20/22
Chloromethane	74-87-3	50	105	100	210	R12, 40, 48/20

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
1-Chloro-4-nitrobenzene	100-00-5	-	1	-	2	Sk R23/24/25, 40, 48/20/21/22, 68, 51/53*
Chlorosulphonic acid	7790-94-5	-	1	-	-	R14, 35, 37
Chlorpyrifos (ISO)	2921-88-2	-	0.2	-	0.6	Sk R25, 50/53*
Chromium	7440-47-3	-	0.5	-	-	
Chromium (II) compounds (as Cr)		-	0.5	-	-	
Chromium (III) compounds (as Cr)		-	0.5	-	-	
Chromium (VI) compounds (as Cr)		-	0.05	-	-	Carc, Sen* BMGV
Cobalt and cobalt compounds (as Co)		-	0.1	-	-	Carc (cobalt dichloride and sulphate) Sen
Copper	7440-50-8					
fume		-	0.2	-	-	
dusts and mists (as Cu)		-	1	-	2	
Cotton dust	See page 32	-	2.5	-	-	
Cryofluorane (INN)	76-14-2	1000	7110	1250	8890	
Cumene	98-82-8	25	125	50	250	Sk R10, 37, 65, 51/53
Cyanamide	420-04-2	0.58	1	-	-	Sk R21, 25, 36/38, 43
Cyanides, except HCN, cyanogen and cyanogen chloride		-	5	-	-	Sk
Cyanogen chloride	506-77-4	-	-	0.3	0.77	
Cyclohexane	110-82-7	100	350	300	1050	R11, 38, 65, 67, 50/53*
Cyclohexanol	108-93-0	50	208	-	-	R20/22, 37/38
Cyclohexanone	108-94-1	10	-	20	-	Sk BMGV R10, 20
Cyclohexylamine	108-91-8	10	41	-	-	R10, 21/22, 34
2,4-D (ISO)	94-75-7	-	10	-	20	R22, 37, 41, 43, 52/53
Dialkyl 79 phthalate	83968-18-7	-	5	-	-	
Diallyl phthalate	131-17-9	-	5	-	-	R22, 50/53*
Diatomaceous earth, natural, respirable dust	61790-53-2	-	1.2	-	-	

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Dibenzoyl peroxide	94-36-0	-	5	-	-	R2, 36, 43
Dibismuth tritelluride	1304-82-1	-	10	-	20	
Diboron trioxide	1303-86-2	-	10	-	20	
1,2-Dibromoethane (Ethylene dibromide)	106-93-4	0.5	3.9	-	-	Carc, Sk R45, 23/24/25, 36/37/38, 51/53*
Dibutyl hydrogen phosphate	107-66-4	1	8.7	2	17	
Dibutyl phthalate	84-74-2	-	5	-	10	R61, 62, 50
Dichloroacetylene	7572-29-4	-	-	0.1	0.39	R2, 40, 48/20
1,2-Dichlorobenzene (*ortho*-dichlorobenzene)	95-50-1	25	153	50	306	Sk R22, 36/37/38, 50/53*
1,4-Dichlorobenzene (*para*-dichlorobenzene)	106-46-7	25	153	50	306	R36, 40, 50/53*
1,3-Dichloro-5,5-dimethyl-hydantoin	118-52-5	-	0.2	-	0.4	
1,1-Dichloroethane	75-34-3	100	-	-	-	Sk R11, 22, 36/37, 52/53*
1,2-Dichloroethane (Ethylene dichloride)	107-06-2	5	21	-	-	Carc, Sk R45, 11, 22, 36/37/38
1,2-Dichloroethylene, cis:trans isomers 60:40	540-59-0	200	806	250	1010	R11, 20, 52/53*
Dichlorofluoromethane	75-43-4	10	43	-	-	
Dichloromethane	75-09-2	100	350	300	1060	Bmgv Sk R40 HSC/E plans to review the limit values for this substance
2,2’-Dichloro-4,4’-methylene dianiline (MbOCA)	101-14-4	-	0.005	-	-	Carc Sk Bmgv R45, 22, 50/53
Dicyclohexyl phthalate	84-61-7	-	5	-	-	
Dicyclopentadiene	77-73-6	5	27	-	-	R11, 20/22, 36/37/38 51/53
Diethylamine	109-89-7	5	15	10	30	R11, 20/21/22, 35
Diethyl ether	60-29-7	100	310	200	620	R12, 19, 22, 66, 67
Diethyl phthalate	84-66-2	-	5	-	10	

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Diethyl sulphate	64-67-5	0.05	0.32	-	-	Carc Sk R45, 46, 20/21/22, 34
Dihydrogen selenide (as Se)	7783-07-5	0.02	-	0.05	-	R23/25, 33
Diisobutyl phthalate	84-69-5	-	5	-	-	
Diisodecyl phthalate	26761-40-0	-	5	-	-	
Diisononyl phthalate	28553-12-0	-	5	-	-	
Diisooctyl phthalate	27554-26-3	-	5	-	-	
Diisopropylamine	108-18-9	5	21	-	-	R11, 20/22, 34
Diisopropyl ether	108-20-3	250	1060	310	1310	R11, 19, 66, 67
N,N-Dimethylacetamide	127-19-5	10	36	20	72	Sk BMGV R20/21, 61
N,N-Dimethylaniline	121-69-7	5	25	10	50	Sk R23/24/25, 40, 51/53
N,N-Dimethylethylamine	598-56-1	10	30	15	46	R12, 20/22, 34
Dimethoxymethane	109-87-5	1000	3160	1250	3950	
Dimethylamine	124-40-3	2	3.8	6	11	R12, 20, 37/38, 41
2-Dimethylaminoethanol	108-01-0	2	7.4	6	22	R10, 20/21/22, 34
Dimethyl ether	115-10-6	400	766	500	958	R12
Dimethylformamide	68-12-2	10	30	20	61	Sk R61, 20/21, 36
2,6-Dimethylheptan-4-one	108-83-8	25	148	-	-	R10, 37
Dimethyl phthalate	131-11-3	-	5	-	10	
Dimethyl sulphate	77-78-1	0.05	0.26	-	-	Carc Sk R45, 25, 26, 34, 43, 68*
Dinitrobenzene, all isomers	25154-54-5	0.15	1	0.5	3.5	Sk R26/27/28, 33, 50, 53
Dinonyl phthalate	84-76-4	-	5	-	-	
1,4-Dioxane	123-91-1	25	91	100	366	Sk R11, 19, 36/37, 40, 66
Diphenylamine	122-39-4	-	10	-	20	R23/24/25, 33, 50/53
Diphenyl ether (vapour)	101-84-8	1	7.1	-	-	
Diphosphorus pentasulphide	1314-80-3	-	1	-	2	R11, 20/22, 29, 50
Diphosphorus pentoxide	1314-56-3	-	1	-	2	R35

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Diquat dibromide (ISO)	85-00-7	-	0.5	-	1	R22, 26, 36/37/38, 43, 48/25, 50/53
Disodium disulphite	7681-57-4	-	5	-	-	R22, 31, 41
Disodium tetraborate, anhydrous	1330-43-4	-	1	-	-	
Disodium tetraborate, decahydrate	1330-96-4	-	5	-	-	
Disodium tetraborate, pentahydrate	11130-12-4	-	1	-	-	
Disulphur dichloride	10025-67-9	-	-	1	5.6	R14, 20, 25, 29, 35, 50
2,6-Di-*tert*-butyl-p-cresol	128-37-0	-	10	-	-	
6,6’-Di-tert-butyl-4,4’-thiodi-*m*-cresol	96-69-5	-	10	-	20	
Diuron (ISO)	330-54-1	-	10	-	-	R22, 40, 48/22, 50/53
Emery	1302-74-5					
inhalable dust		-	10	-	-	
respirable		-	4	-	-	
Endosulfan (ISO)	115-29-7	-	0.1	-	0.3	Sk R24/25, 36, 50/53
Enflurane	13838-16-9	50	383	-	-	
Ethane-1,2-diol	107-21-1					Sk
particulate		-	10	-	-	R22
vapour		20	52	40	104	
Ethanethiol	75-08-1	0.5	1.3	2	5.2	R11, 20, 50/53
Ethanol	64-17-5	1000	1920	-	-	R11
2-Ethoxyethanol	110-80-5	10	37	-	-	Sk R10, 20/21/22, 60, 61 HSC/E plans to review the limit values for this substance
2-Ethoxyethyl acetate	111-15-9	10	55	-	-	Sk R20/21/22, 60, 61
2-Ethylhexyl chloroformate	24468-13-1	1	8	-	-	
Ethyl acetate	141-78-6	200	-	400	-	R11, 36, 66, 67
Ethyl acrylate	140-88-5	5	21	15	62	R11, 20/21/22, 36/37/38, 43
Ethylamine	75-04-7	2	3.8	6	11	R12, 36/37
Ethylbenzene	100-41-4	100	441	125	552	Sk R11, 20

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Ethyl chloroformate	541-41-3	1	4.5	-	-	R11, 22, 26, 34
Ethyl cyanoacrylate	7085-85-0	-	-	0.3	1.5	R36/37/38
Ethyl formate	109-94-4	100	308	150	462	R11, 20/22, 36/37
Ethylene oxide	75-21-8	5	9.2	-	-	Carc R45, 46, 12, 23 36/37/38
4-Ethylmorpholine	100-74-3	5	24	20	96	Sk
Ferrous foundry particulate	See page 32					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Flour dust	See page 33	-	10	-	30	Sen HSC/E plans to review the limit values for this substance
Fluoride (inorganic as F)	16984-48-8	-	2.5	-	-	
Fluorine	7782-41-4	1	-	1	-	R7, 26, 35
Formaldehyde	50-00-0	2	2.5	2	2.5	R23/24/25, 34, 40, 43 HSC/E plans to review the limit values for this substance
Formamide	75-12-7	20	37	30	56	R61
Formic acid	64-18-6	5	9.6	-	-	R35
2-Furaldehyde (furfural)	98-01-1	2	8	5	20	Sk R21, 23/25, 36/37, 40
Germane	7782-65-2	0.2	0.64	0.6	1.9	
Glutaraldehyde	111-30-8	0.05	0.2	0.05	0.2	Sen R23/25, 34, 42/43, 50
Glycerol, mist	56-81-5	-	10	-	-	
Grain dust	See page 33	-	10	-	-	Sen
Graphite	7440-44-0					
inhalable dust		-	10	-	-	
respirable		-	4	-	-	
Gypsum	10101-41-4					
inhalable dust		-	10	-	-	
respirable		-	4	-	-	

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Halogeno-platinum compounds (complex co-ordination compounds in which the platinum atom is directly co-ordinated to halide groups) (as Pt)	See page 33	-	0.002	-	-	Sen
Halothane	151-67-7	10	82	-	-	
Hardwood dust	See page 35	-	5	-	-	Carc Sen HSC/E plans to review the limit values for this substance
n-Heptane	142-82-5	500	-	-	-	R11, 38, 65, 67, 50/53
Heptan-2-one	110-43-0	50	237	100	475	Sk R10, 20/22
Heptan-3-one	106-35-4	35	166	100	475	Sk R10, 20, 36
n-Hexane	110-54-3	20	72	-	-	R11, 38, 48/20, 62, 65, 67, 51/53*
1,6-Hexanolactam	105-60-2					R20/22, 36/37/38
dust only		-	1	-	3	
dust and vapour		-	10	-	20	
Hexan-2-one	591-78-6	5	21	-	-	Sk R10, 48/23, 62, 67
Hydrazine	302-01-2	0.02	0.03	0.1	0.13	Carc Sk R45, 10, 23/24/25, 34, 43, 50/53
Hydrogen bromide	10035-10-6	-	-	3	10	R35, 37
Hydrogen chloride (gas and aerosol mists)	7647-01-0	1	2	5	8	R23, 35
Hydrogen cyanide	74-90-8	-	-	10	11	Sk R12, 26, 50/53
Hydrogen fluoride (as F)	7664-39-3	1.8	1.5	3	2.5	R26/27/28, 35
Hydrogen peroxide	7722-84-1	1	1.4	2	2.8	R5, 8, 20/22, 35*
Hydrogen sulphide	7783-06-4	5	7	10	14	R12, 26, 50
Hydroquinone	123-31-9	-	0.5	-	-	R22, 40, 41, 43, 68, 50
4-Hydroxy-4-methylpentan-2-one	123-42-2	50	241	75	362	R36
2-Hydroxypropyl acrylate	999-61-1	0.5	2.7	-	-	Sk R23/24/25, 34, 43

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
2,2'-Iminodi(ethylamine)	111-40-0	1	4.3	-	-	Sk R21/22, 34, 43
Indene	95-13-6	10	48	15	72	
Indium and compounds (as In)		-	0.1	-	0.3	
Iodine	7553-56-2	-	-	0.1	1.1	R20/21, 50
Iodoform	75-47-8	0.6	9.8	1	16	
Iodomethane	74-88-4	2	12	-	-	Sk R21, 23/25, 37/38, 40
Iron oxide, fume (as Fe)	1309-37-1	-	5	-	10	
Iron salts (as Fe)		-	1	-	2	
Isobutyl acetate	110-19-0	150	724	187	903	R11, 66
Isocyanates, all (as -NCO)		-	0.02	-	0.07	Sen HSC/E plans to review the limit values for this substance
Isoflurane	26675-46-7	50	383	-	-	
Isooctyl alcohol (mixed isomers)	26952-21-6	50	271	-	-	
Isopropyl acetate	108-21-4	-	-	200	849	R11, 36, 66, 67
Isopropyl chloroformate	108-23-6	1	5.1	-	-	
Kaolin, respirable dust	1332-58-7	-	2	-	-	
Ketene	463-51-4	0.5	0.87	1.5	2.6	
Limestone	1317-65-3					
total inhalable		-	10	-	-	
respirable		-	4	-	-	
Liquefied petroleum gas	68476-85-7	1000	1750	1250	2180	Carc (only applies if LPG contains more than 0.1% of buta-1, 3-diene) R12
Lithium hydride	7580-67-8	-	0.025	-	-	
Lithium hydroxide	1310-65-2	-	-	-	1	
Magnesite	546-93-0					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Magnesium oxide (as Mg)	1309-48-4					
inhalable dust		-	10	-	-	
fume and respirable dust		-	4	-	-	
Malathion (ISO)	121-75-5	-	10	-	-	Sk R22, 50/53*
Maleic anhydride	108-31-6	-	1	-	3	Sen R22, 34, 42/43
Manganese and its inorganic compounds (as Mn)		-	0.5	-	-	
Marble	1317-65-3					
total inhalable		-	10	-	-	
respirable		-	4	-	-	
Mercaptoacetic acid	68-11-1	1	3.8	-	-	R23/24/25, 34
Methacrylic acid	79-41-4	20	72	40	143	R21/22, 35
Methacrylonitrile	126-98-7	1	2.8	-	-	Sk R11, 23/24/25, 43*
Methanethiol	74-93-1	0.5	1.0	-	-	R12, 23, 50/53*
Methanol	67-56-1	200	266	250	333	Sk R11, 23/24/25, 39/23/24/25
2-Methoxyethanol	109-86-4	5	16	-	-	Sk R10, 20/21/22, 60, 61
2-Methoxyethyl acetate	110-49-6	5	25	-	-	Sk R20/21/22, 60, 61
(2-methoxymethylethoxy) propanol	34590-94-8	50	308	-	-	Sk
1-Methoxypropan-2-ol	107-98-2	100	375	150	560	Sk R10
1-Methoxypropyl acetate	108-65-6	50	274	100	548	Sk R10, 36
Methyl acetate	79-20-9	200	616	250	770	R11, 36, 66, 67
3-Methylbutan-1-ol	123-51-3	100	366	125	458	
Methyl cyanoacrylate	137-05-3	-	-	0.3	1.4	R36/37/38
4,4'-Methylenedianiline	101-77-9	0.01	0.08	-	-	Carc Sk Bmgv R45, 39/23/24/25, 43, 48/20/21/22, 68, 51/53
Methyl ethyl ketone peroxides (MEKP)	1338-23-4	-	-	0.2	1.5	

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Methyl methacrylate	80-62-6	50	208	100	416	R11, 37/38, 43
2-Methylcyclohexanone	583-60-8	50	233	75	350	R10, 20
Methylcyclohexanol	25639-42-3	50	237	75	356	
N-Methylaniline	100-61-8	0.5	2.2	-	-	Sk R23/24/25, 33, 50/53
5-Methylheptan-3-one	541-85-5	10	-	20	-	R10, 36/37
5-Methylhexan-2-one	110-12-3	20	95	100	475	Sk R10, 20
2-Methylpentane-2,4-diol	107-41-5	25	123	25	123	R36/38
4-Methylpentan-2-ol	108-11-2	25	106	40	170	Sk R10, 37
4-Methylpentan-2-one	108-10-1	50	208	100	416	Sk Bmgv R11, 20, 36/37, 66
2-Methylpropan-1-ol	78-83-1	50	154	75	231	R10, 37/38, 41, 67
2-Methylpropan-2-ol	75-65-0	100	308	150	462	R20
1-Methyl-2-pyrrolidone	872-50-4	25	103	75	309	Sk R36/38
Methyl-*tert*-butyl ether	1634-04-4	25	92	75	275	R11, 38*
Mica	12001-26-2					
total inhalable		-	10	-	-	
respirable		-	0.8	-	-	
MMMF (Machine-made mineral fibre) (except for Refractory Ceramic Fibres and Special Purpose Fibres)		5 $mg.m^{-3}$ and 2 fibres/mililitre		-	-	HSC/E plans to review the limit values for this substance
Molybdenum compounds (as Mo)						
soluble compounds		-	5	-	10	
insoluble compounds		-	10	-	20	
Monochloroacetic acid	79-11-8	0.3	1.2	-	-	Sk R25, 34, 50
Morpholine	110-91-8	10	36	20	72	Sk R10, 20/21/22, 34

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period) ppm	$mg.m^{-3}$	Short-term exposure limit (15-minute reference period) ppm	$mg.m^{-3}$	
Nickel and its inorganic compounds (except nickel tetracarbonyl):						Sk Carc (nickel oxides and sulphides) Sen (nickel sulphate)
water-soluble nickel compounds (as Ni)		-	0.1	-	-	
nickel and water-insoluble nickel compounds (as Ni)		-	0.5	-	-	
Nicotine	54-11-5	-	0.5	-	1.5	Sk R25, 27, 51/53
Nitric acid	7697-37-2	-	-	1	2.6	R8, 35
Nitrobenzene	98-95-3	0.2	1	-	-	Sk R23/24/25, 40, 48/23/24, 62, 51/53
Nitromethane	75-52-5	100	254	150	381	R5, 10, 22
2-Nitropropane	79-46-9	5	19	-	-	Carc R45, 10, 20/22
Nitrous oxide	10024-97-2	100	183	-	-	
Orthophosphoric acid	7664-38-2	-	1	-	2	R34
Osmium tetraoxide (as Os)	20816-12-0	0.0002	0.002	0.0006	0.006	R26/27/28, 34
Oxalic acid	144-62-7	-	1	-	2	R21/22
2,2'-Oxydiethanol	111-46-6	23	101	-	-	R22
Ozone	10028-15-6	-	-	0.2	0.4	
Paracetamol, inhalable dust	103-90-2	-	10	-	-	
Paraffin wax, fume	8002-74-2	-	2	-	6	
Paraquat dichloride (ISO), respirable dust	1910-42-5	-	0.08	-	-	R24/25, 26, 36/37/38, 48/25, 50/53
Pentacarbonyliron (as Fe)	13463-40-6	0.01	0.08	-	-	
Pentaerythritol	115-77-5					
inhalable dust		-	10	-	20	
respirable dust		-	4	-	-	
Pentan-2-one	107-87-9	200	716	250	895	
Pentan-3-one	96-22-0	200	716	250	895	R11, 37, 66, 67
Pentyl acetates (all isomers)		50	270	100	541	R10, 66
2-Phenylpropene	98-83-9	50	246	100	491	R10, 36/37, 51/53*

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Phenol	108-95-2	2	-	-	-	Sk R23/24/25, 34, 48/20/21/22, 68*
p-Phenylenediamine	106-50-3	-	0.1	-	-	Sk R23/24/25, 36, 43, 50/53
Phorate (ISO)	298-02-2	-	0.05	-	0.2	Sk R27/28, 50/53
Phosgene	75-44-5	0.02	0.08	0.06	0.25	R26, 34
Phosphine	7803-51-2	0.1	0.14	0.2	0.28	R12, 17, 26, 34, 50*
Phosphorus pentachloride	10026-13-8	0.1	0.87	0.2	2	R14, 22, 26, 34, 48/20
Phosphorus trichloride	7719-12-2	0.2	1.1	0.5	2.9	R14, 26/28, 35, 48/20
Phosphorus, yellow	7723-14-0	-	0.1	-	0.3	R11, 16, 52/53
Phosphoryl trichloride	10025-87-3	0.2	1.3	0.6	3.8	R14, 22, 26, 35, 48/23
Phthalic anhydride	85-44-9	-	4	-	12	Sen R22, 37/38, 41, 42/43
Picloram (ISO)	1918-02-1	-	10	-	20	
Picric acid	88-89-1	-	0.1	-	0.3	R2, 4, 23/24/25
Piperazine	110-85-0	-	0.1	-	0.3	Sen R34, 42/43, 52/53
Piperazine dihydrochloride	142-64-3	-	0.1	-	0.3	Sen
Piperidine	110-89-4	1	3.5	-	-	Sk R11, 23/24, 34
Plaster of Paris	26499-65-0					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Platinum compds, soluble (except certain halogeno-Pt compounds) (as Pt)		-	0.002	-	-	
Platinum metal	7440-06-4	-	5	-	-	
Polychlorinated biphenyls (PCB)	1336-36-3	-	0.1	-	-	Sk R33, 50/53*
Polyvinyl chloride	9002-86-2					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Portland cement	65997-15-1					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Potassium hydroxide	1310-58-3	-	-	-	2	R22, 35

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Propane-1,2-diol	57-55-6					
total vapour and particulates		150	474	-	-	
particulates		-	10	-	-	
Propan-1-ol	71-23-8	200	500	250	625	Sk R11, 41, 67
Propan-2-ol	67-63-0	400	999	500	1250	R11, 36, 67
Propionic acid	79-09-4	10	31	15	46	R34
Propoxur (ISO)	114-26-1	-	0.5	-	2	R25, 50/53
Propranolol	525-66-6	-	2	-	6	
n-Propyl acetate	109-60-4	200	849	250	1060	R11, 36, 66, 67
Propylene oxide	75-56-9	5	12	-	-	Carc R45, 46, 12, 20/21/22, 36/37/38
Prop-2-yn-1-ol	107-19-7	1	2.3	3	7	Sk R10, 23/24/25, 34, 51/53
Pulverised fuel ash						
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Pyridine	110-86-1	5	16	10	33	R11, 20/21/22
2-Pyridylamine	504-29-0	0.5	2	2	7.8	
Pyrocatechol	120-80-9	5	23	-	-	R21/22, 36/38
Refractory Ceramic Fibres and Special Purpose Fibres		5 mg.m^{-3} 1 fibre/mililitre		-	-	Carc R49, 38
Resorcinol	108-46-3	10	46	20	92	Sk R22, 36/38, 50
Rhodium (as Rh)						
metal fume and dust		-	0.1	-	0.3	
soluble salts		-	0.001	-	0.003	
Rosin-based solder flux fume	8050-09-7	-	0.05	-	0.15	Sen
Rotenone (ISO)	83-79-4	-	5	-	10	R25, 36/37/38, 50/53
Rouge	1309-37-1					
total inhalable		-	10	-	-	
respirable		-	4	-	-	
Rubber fume	See page 30	-	0.6	-	-	Carc Limit relates to cyclohexane soluble material

Substance	CAS number	Workplace exposure limit				Comments
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Rubber process dust	See page 30	-	6	-	-	Carc HSC/E plans to review the limit values for this substance
Selenium and compounds, except hydrogen selenide (as Se)		-	0.1	-	-	
Silane	7803-62-5	0.5	0.67	1	1.3	
Silica, amorphous						
inhalable dust		-	6	-	-	
respirable dust		-	2.4	-	-	
Silica, respirable crystalline	See page 34	-	0.3	-	-	HSC/E plans to review the limit values for this substance
Silica, fused respirable dust	60676-86-0	-	0.08	-	-	
Silicon	7440-21-3					
inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Silicon carbide (not whiskers)	409-21-2					
total inhalable		-	10	-	-	
respirable		-	4	-	-	
Silver (soluble compounds as Ag)		-	0.01	-	-	
Silver, metallic	7440-22-4	-	0.1	-	-	
Sodium azide (as NaN_3)	26628-22-8	-	0.1	-	0.3	Sk R28, 32, 50/53
Sodium 2-(2,4-dichlorophenoxy) ethyl sulphate	136-78-7	-	10	-	20	
Sodium hydrogen sulphite	7631-90-5	-	5	-	-	R22, 31
Sodium hydroxide	1310-73-2	-	-	-	2	R35
Softwood dust	See page 34	-	5	-	-	Sen HSC/E plans to review the limit values for this substance
Starch	9005-25-8					
total inhalable		-	10	-	-	
respirable		-	4	-	-	

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	mg.m^{-3}	ppm	mg.m^{-3}	
Styrene	100-42-5	100	430	250	1080	R10, 20, 36/38 HSC/E plans to review the limit values for this substance
Subtilisins	1395-21-7 (*Bacillus subtilis* BPN) 9014-01-1 (*Bacillus subtilis* Carlsberg)	-	0.00004	-	-	Sen R37/38, 41, 42
Sucrose	57-50-1	-	10	-	20	
Sulfotep (ISO)	3689-24-5	-	0.1	-	-	Sk R27/28, 50/53*
Sulphur hexafluoride	2551-62-4	1000	6070	1250	7590	
Sulphuryl difluoride	2699-79-8	5	21	10	42	R23, 48/20, 50*
o-Toluidine	95-53-4	0.2	0.89	-	-	Carc Sk R45, 23/25, 36, 50
Talc, respirable dust	14807-96-6	-	1	-	-	
Tantalum	7440-25-7	-	5	-	10	
Tellurium & compounds, except hydrogen telluride, (as Te)		-	0.1	-	-	
Terphenyls, all isomers	26140-60-3	-	-	0.5	4.8	
1,1,2,2-Tetrabromoethane	79-27-6	0.5	7.2	-	-	Sk R26, 36, 52/53*
Tetracarbonylnickel	13463-39-3	-	-	0.1	0.24	R11, 26, 40, 61, 50/53
Tetrachloroethylene	127-18-4	50	345	100	689	R40, 50/53
1,1,1,2-Tetrafluoroethane (HFC 134a)	811-97-2	1000	4240	-	-	
Tetrahydrofuran	109-99-9	50	150	100	300	Sk R11, 19, 36/37
Tetrasodium pyrophosphate	7722-88-5	-	5	-	-	
Thallium, soluble compounds (as Tl)		-	0.1	-	-	Sk
Thionyl chloride	7719-09-7	-	-	1	4.9	R14, 20/22, 29, 35
Tin compounds, inorganic, except SnH_4, (as Sn)		-	2	-	4	

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Tin compounds, organic, except Cyhexatin (ISO), (as Sn)		-	0.1	-	0.2	Sk
Titanium dioxide	13463-67-7					
total inhalable		-	10	-	-	
respirable		-	4	-	-	
Toluene	108-88-3	50	191	100	384	Sk R11, 38, 48/20, 63, 65, 67*
p-Toluenesulphonyl chloride	98-59-9	-	-	-	5	
Tributyl phosphate, all isomers	126-73-8	-	5	-	5	R22, 38, 40*
1,2,4-Trichlorobenzene	120-82-1	1	-	5	-	Sk R22, 38, 50/53
1,1,1-Trichloroethane	71-55-6	100	555	200	1110	R20, 59
Trichloroethylene	79-01-6	100	550	150	820	Carc, Sk R45, 36/38, 67, 52/53 HSC/E plans to review the limit values for this substance
Trichloronitromethane	76-06-2	0.1	0.68	0.3	2.1	R22, 26, 36/37/38
Triethylamine	121-44-8	2	8	4	17	Sk R11, 20/21/22, 35
Triglycidyl isocyanurate (TGIC)	2451-62-9	-	0.1	-	-	Carc R46, 23/25, 41, 43, 48/22, 52/53
Trimellitic anhydride	552-30-7	-	0.04	-	0.12	Sen R37, 41, 42/43
Trimethylbenzenes, all isomers or mixtures	25551-13-7	25	125	-	-	
3,5,5-trimethylcyclohex-2-enone	78-59-1	-	-	5	29	R21/22, 36/37, 40
Trimethyl phosphite	121-45-9	2	10	-	-	
2,4,6-Trinitrotoluene	118-96-7	-	0.5	-	-	Sk R2, 23/24/25, 33, 51/53
Tri-o-tolyl phosphate	78-30-8	-	0.1	-	0.3	R39/23/24/25, 51/53
Triphenyl phosphate	115-86-6	-	3	-	6	
Tungsten & compounds (as W)	7440-33-7					
soluble compounds		-	1	-	3	
insoluble compounds and others		-	5	-	10	

Substance	**CAS number**	**Workplace exposure limit**				**Comments**
		Long-term exposure limit (8-hour TWA reference period)		Short-term exposure limit (15-minute reference period)		
		ppm	$mg.m^{-3}$	ppm	$mg.m^{-3}$	
Turpentine	8006-64-2	100	566	150	850	R10, 20/21/22, 36/38, 43, 65, 51/53
Vanadium pentoxide	1314-62-1	-	0.05	-	-	R20/22, 37, 48/23, 63, 68, 51/53
Vinyl chloride	75-01-4	3	-	-	-	Carc R45, 12
Vinylidene chloride	75-35-4	10	40	-	-	R12, 20, 40*
Wool process dust	See page 34	-	10	-	-	
Xylene, *o-*,*m-*,*p-* or mixed isomers	1330-20-7	50	220	100	441	Sk BMGV R10, 20/21, 38
Yttrium	7440-65-5	-	1	-	3	
Zinc chloride, fume	7646-85-7	-	1	-	2	R22, 34, 50/53*
Zinc distearate	557-05-1					
inhalable dust		-	10	-	20	
respirable dust		-	4	-	-	
Zirconium compounds (as Zr)		-	5	-	10	

Table 2: Biological Monitoring Guidance Values

17 The framework for the use of biological monitoring and the setting of Biological Monitoring Guidance Values (BMGVs) is detailed in paragraphs 114-116. For each substance with a BMGV a free information sheet briefly describing a suggested analytical method, appropriate sampling strategy, the availability of quality assurance schemes and interpretation of results is available. Information sheets can be obtained from HSE's Health and Safety Laboratory, Biomedical Sciences Group, Health & Safety Laboratory, Health Sciences (or Biological Monitoring), Buxton, Derbyshire, SK17 9JN (Website: www.hsl.gov.uk).

Substance	Biological Monitoring Guidance Values	Sampling time
Butan-2-one	70 µmol butan-2-one/L in urine	Post shift
2-Butoxyethanol	240 mmol butoxyacetic acid/mol creatinine in urine	Post shift
Carbon monoxide	30 ppm carbon monoxide in end-tidal breath	Post shift
Chromium VI	10 µmol chromium/mol creatinine in urine	Post shift
Cyclohexanone	2 mmol cyclohexanol/mol creatinine in urine	Post shift
Dichloromethane	30 ppm carbon monoxide in end-tidal breath	Post shift
N,N-Dimethylacetamide	100 mmol N-methylacetamide/mol creatinine in urine	Post shift
Glycerol trinitrate (Nitroglycerin)	15 µmol total nitroglycols/mol creatinine in urine	At the end of the period of exposure
Lindane (BHC(ISO))	35 nmol/L (10 µg/L) of lindane in whole blood (equivalent to 70 nmol/L of lindane in plasma)	Random
MbOCA (2,2' dichloro-4,4' methylene dianiline)	15 µmol total MbOCA/mol creatinine in urine	Post shift
Mercury	20 µmol mercury/mol creatinine in urine	Random
4-methylpentan-2-one	20 µmol 4-methylpentan-2-one/L in urine	Post shift
4,4'-Methylenedianimile (MDA)	50 µmol total MDA/mol creatinine in urine	Post shift for inhalation and pre-shift next day for dermal exposure
Polycyclic aromatic hydrocarbons (PAHs)	4 µmol 1-hydroxypyrene/mol creatinine in urine	Post shift
Xylene, o-, m-, p- or mixed isomers	650 mmol methyl hippuric acid/mol creatinine in urine	Post shift

Supplementary information for Table 1

Definitions

Cotton dust

18 Cotton is the cellulose fibre that grows inside the seed pods (or bolls) of the cotton plant. When mature, the boll breaks and the cotton appears as a soft wad of fine fibres. After picking, the cotton is separated from the seed etc, and is packed and compressed into bales.

19 The WEL, which is based on personal sampling, applies to exposure to inhalable dust during the handling of raw and waste cotton including blends containing raw or waste cotton, with the following exceptions:

(a) dust from weaving, knitting, braiding and subsequent processes;

(b) dust from bleached or dyed cotton; and

(c) dust from finished articles, for example garments.

(Where the WEL does not apply, exposure should still be adequately controlled.)

20 MDHS14/3 *General methods for sampling and gravimetric analysis of respirable and inhalable dust*[13] gives information about air sampling for comparison with the WEL. The sampler should be an IOM inhalable dust sampler or any other sampler giving equivalent results.

Ferrous foundry particulate

21 The atmospheric contamination in ferrous (iron and steel) foundries is a complex mixture of dust, fume, gases and vapours produced as a consequence of the foundry processes. The particulate fraction of the atmospheric contamination is described as ferrous foundry particulate (FFP). The composition of FFP will vary according to the process producing it and the materials used.

22 During the making of cores and moulds, vapours and gases from the binder system may be given off, and particles of sand, including respirable silica (possibly coated with unreacted or reacted binder materials) can become airborne. When molten metal is poured into the moulds, decomposition products can be produced from organic binders and additives in the mould. The decomposition products may bind to particles of sand or metal oxide. At knockout and shakeout, sand particles (which may be coated with thermally degraded binder material) are the main contaminants produced. Metal finishing operations can give rise to fume as well as airborne metal, metal oxide particles and coated sand particles.

23 Some of the individual components of the atmospheric contamination are known to be carcinogenic or mutagenic and some have been assigned WELs. The interrelationship between the components of FFP is complex and it is inappropriate to rely on the individual WELs in assessing overall exposure to airborne contaminants in the foundry atmosphere. Airborne particulate is considered to be a suitable surrogate for overall exposure assessment in ferrous foundries. FFP is measured as total inhalable particulate (TIP) and respirable particulate (RP). Where identified components of the contamination have WELs these limits will apply.

Flour dust

24 Flour dust is taken to be finely ground particles of cereals or pulses (including contaminants) that result from any grinding process and from any subsequent handling and use of that 'flour'. Any additives (eg flour improvers) are included in this definition only after they have been added to the final product mix.

Grain dust

25 Grain dust is taken to be dust arising from the harvesting, drying, handling, storage or processing of barley, wheat, oats, maize and rye, including contaminants.

Halogeno-platinum compounds

26 These are co-ordination compounds in which a platinum atom or ion is directly co-ordinated to one or more halide (ie fluoride, chloride, bromide or iodide) ions. These compounds are subject to a WEL and have a Sen notation. These substances are listed in section C of *Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma*.[4]

27 For substances which, although they contain platinum and halide ions, the halogen is not directly co-coordinated by a chemical bond to the platinum, the WEL for soluble platinum compounds is applicable.

Machine-made mineral fibres (MMMF)

28 Machine-made (formerly 'man-made') mineral fibres are defined as man-made vitreous (silicate) fibres with random orientation with alkaline oxide and alkali earth oxide ($Na_2O+K_2O+CaO+MgO+BaO$) content greater than 18% by weight. Neither the gravimetric limit nor the fibres in air limits should be exceeded. Fibre concentrations of MMMFs must be measured or calculated by a method approved by HSC.

29 A separate limit applies to other MMMFs which are not covered by this definition (see paragraph 31).

Pulverised fuel ash

30 Pulverised fuel ash (PFA), sometimes known as precipitation ash, is a fine grey fuel ash powder, composed mainly of alumino-silicate amorphous spheres. It is produced when pulverised coal is burnt in a coal-fired power station. It is collected and separated into various grades for use as a filler in civil engineering and land reclamation, in ready-mix concrete, as a grout in block/cementitious products and in the manufacture of other products used by the construction industry.

Refractory ceramic fibre (RCF)

31 RCFs are man-made vitreous (silicate) fibres with random orientation with alkaline oxide and alkali earth oxide ($Na_2O+K_2O+CaO+MgO+BaO$) content less or equal to 18% by weight. The term 'RCF' also includes non-oxide ceramic fibre such as boron and silicon carbides and nitrides. Fibre concentrations of RCF must be measured or calculated by a method approved by the HSC.

Rubber fume and rubber process dust

32 Rubber fume is fume evolved in the mixing, milling and blending of natural rubber or synthetic elastomers, or of natural rubber and synthetic polymers combined with chemicals, and in the processes which convert the resultant blends into finished process dust products or parts thereof, and including any inspection procedures where fume continues to be evolved.

33 The limit relates to cyclohexane soluble material determined by the method described in MDHS47/2 *Determination of rubber process dust and rubber fume in air.*[14]

34 Rubber process dust is dust arising in the stages of rubber manufacture where ingredients are handled, weighed, added to or mixed with uncured material or synthetic elastomers. It does not include dusts arising from the abrasion of cured rubber.

35 Where the airborne material contains a mixture of substances, one or more of which is assigned a WEL, that limit will apply to the individual substance and at the same time the rubber process dust limit will apply to the mix dust as a whole. Where the airborne material is effectively a single substance with a WEL, that limit alone will apply.

36 Methods for personal sampling and measurement of inhalable dusts are available in MDHS14/3: *General methods for sampling and gravimetric analysis of respirable and inhalable dust*[13] and MDHS47/2: *Determination of rubber process dust and rubber fume in air*.[14] As with the fume, the dust is determined gravimetrically but, unlike the fume, the dust determination does not involve solvent extraction.

Note: Dust produced by the abrasion of cured rubber should be dealt with as described in paragraphs 42-45, ie dust of any kind when present at a substantial concentration in air is covered by COSHH.

Subtilisins

37 Subtilisins are proteolytic enzymes derived from *Bacillus subtilis*.They are used in biological washing powders, animal feedstuffs etc. The enzyme preparation contains active enzyme, inactive enzyme and protein residues. The WEL for subtilisins is 0.00004 mg.m^{-3} (8-hr TWA) - 40 ng.m^{-3} - crystalline active pure enzyme. One of the suitable measurement methods is the fluorescence polarisation technique developed by the Health and Safety Laboratory (HSL). The previous limit for subtilisin was based on high-volume static sampling to achieve sufficient sensitivity. However, improvements in the analytical methodology have improved the sensitivity and the WEL for subtilisin reflects this. The limit is based on standard personal sampling (MDHS14/3).[13] Short-term reference period (15 minute) sampling is not appropriate.

Talc

38 Talc is defined as the mineral talc together with other hydrous phyllosilicates including chlorite and carbonate materials which occur with it, but excluding amphibole asbestos and crystalline silica.

Wood dust

39 Wood dust is a general term covering a wide variety of airborne wood dusts. Timbers have been divided into two different groups, namely hardwoods and softwoods. Hardwoods are timbers from deciduous trees, including trees from both temperate and tropical zones, such as beech, ash, oak, mahogany and teak. Softwoods are mainly from coniferous trees such as Scots pine, yew and cedar.

40 Dust is generated by the machining and working of wood and wood-containing materials such as chipboard and fibreboard. Operations such as sawing, turning and routing produce relatively coarse dust, while sanding and assembly operations generate fine dust.

Wool process dust

41 Wool process dust is the term used to describe the dust generated in the production of woollen and worsted textiles. This includes all factory processes from the receipt of the raw wool up to the finished product in the case of carpet manufacture, and up to, and including, weaving, knitting or non-woven cloth production. It does not cover agricultural processes, including any sorting or baling done on the farm. The term ‘wool’, in this case, refers to sheep’s wool and wool

blends only. It does not include other speciality fibres - such as goat hair (including cashmere and mohair), camel hair or alpaca. Such fibres differ from wool in structure and it is not certain that the composition of the dust or the potential health risk is the same as with wool process dust.

Dust

42 The COSHH definition of a substance hazardous to health includes dust of any kind when present at a concentration in air equal to or greater than 10 mg.m^{-3} 8-hour TWA of inhalable dust or 4 mg.m^{-3} 8-hour TWA of respirable dust. This means that any dust will be subject to COSHH if people are exposed above these levels. Advice on control is given in EH44 *Dust: General principles of protection*[15] and in the great majority of workplaces reasonable control measures will normally keep exposure below these levels. However, some dusts have been assigned specific WELs and exposure to these must comply with the appropriate limit.

43 Most industrial dusts contain particles of a wide range of sizes. The behaviour, deposition and fate of any particular particle after entry into the human respiratory system and the body response that it elicits, depend on the nature and size of the particle. HSE distinguishes two size fractions for limit-setting purposes termed ‘inhalable’ and ‘respirable’.

44 Inhalable dust approximates to the fraction of airborne material that enters the nose and mouth during breathing and is therefore available for deposition in the respiratory tract. **Respirable dust** approximates to the fraction that penetrates to the gas exchange region of the lung. Fuller definitions and explanatory material are given in MDHS14/3 *General methods for sampling and gravimetric analysis of respirable and inhalable dust.*[13]

45 Where dusts contain components that have their own assigned workplace exposure limits, all the relevant limits should be complied with.

Fume

46 The word ‘fume’ is often used to include gases and vapours. This is not the case for exposure limits where ‘fume’ should normally be applied to solid particles generated by chemical reactions or condensed from the gaseous state, usually after volatilisation from melted substances. The generation of fume is often accompanied by a chemical reaction such as oxidation or thermal breakdown.

Substances which are special cases under COSHH or other legislation

Carcinogenic and mutagenic substances

47 Regulation 7(5) of COSHH sets out clear requirements for the control of carcinogenic and mutagenic substances. Appendix 1 of the COSHH (ACOP) gives additional practical guidance. The ACOP applies to any carcinogenic or mutagen defined as such in COSHH. This will include:

(a) any substance or preparation which if classified in accordance with regulation 5 of the Chemicals (Hazard Information and Packaging for Supply) Regulations would be in the category of danger, carcinogenic (category 1) or carcinogenic (category 2), or mutagenic (category 1) or mutagenic (category 2) whether or not the substance or preparation would be required to be classified under those regulations; or

(b) any substance or preparation listed in Schedule 1 and any substances or preparation arising from a process specified in Schedule 1 which is a substance hazardous to health.

This definition also covers substances and preparations which would require labelling with the risk phrases 'R45', 'R46' or 'R49' if they were not exceptions to all or part of the Chemicals (Hazard Information and Packaging for Supply) Regulations. Examples of these exceptions are medicines, unpackaged substances and substances being moved around within a factory.

48 The substances, preparations and processes defined as carcinogens or mutagens for the purpose of the COSHH Regulations and to which the special provisions for carcinogens and mutagens in the COSHH Regulations apply are listed in the *Approved Supply List*[12] and the COSHH ACOP.[5]

49 A list of the other substances and processes to which the definition of 'carcinogen' relates is given below:

(a) aflatoxins;

(b) arsenic;

(c) auramine manufacture;

(d) calcining, sintering or smelting of nickel copper matte or acid leaching or electrorefining of roasted matte;

(e) coal soots, coal tar, pitch and coal tar fumes;

(f) hardwood dusts;

(g) isopropyl alcohol manufacture (strong acid process);

(h) leather dust in boot and shoe manufacture, arising during preparation and finishing;

(i) magenta manufacture;

(j) mustard gas (ß,ß'-dichlorodiethyl sulphide);

(k) rubber manufacturing and processing giving rise to rubber process dust and rubber fume;

(l) used engine oils;

(m) the following polychlorodibenzodioxins:
  (i) 2,3,7,8-TCDD,
  (ii) 1,2,3,7,8-PeCDD,
  (iii) 1,2,3,4,7,8-HxCDD,
  (iv) 1,2,3,6,7,8-HxCDD,
  (v) 1,2,3,7,8,9 -HxCDD,
  (vi) 1,2,3,4,6,7,8-HpCDD,
  (vii) OCDD;

(n) the following polychlorodibenzofurans:
  (i) 2,3,7,8-TCDF,
  (ii) 2,3,4,7,8-PeCDF,
  (iii) 1,2,3,7,8-PeCDF,
  (iv) 1,2,3,4,7,8-HxCDF,
  (v) 1,2,3,7,8,9-HxCDF,
  (vi) 1,2,3,6,7,8-HxCDF,
  (vii) 2,3,4,6,7,8-HxCDF,

(viii) 1,2,3,4,6,7,8-HpCDF,
(viiii) 1,2,3,4,7,8,9-HpCDF,
(x) OCDF,

where T=tetra, Pe=penta, Hx=hexa, Hp=hepta and O=Octa.

Asbestos

50 Exposure to asbestos must be prevented or, where that is not reasonably practicable, it must be reduced to the lowest level that is reasonably practicable.

51 The Control of Asbestos at Work Regulations[17] set control limits for asbestos based on both 4-hour and 10 minute TWAs. They also set action levels based on cumulative exposure which determine whether or not certain regulations apply in any given case. HSC has approved a method of measurement which must be used when fibre levels are being checked against any of these limits.

52 Information about the exposure limits and measurement methods for asbestos is given in *Asbestos: The analysts' guide for sampling, analysis and clearance procedures*[18] which also contains guidance on the use of airborne fibre measurement in checking the effectiveness of enclosures or other control measures, or for site clearance when work is finished. More technical detail about measurement is also given in this publication.

53 For more information see the control of Asbestos at Work Regulations and supporting ACOPS.[19-22]

Control limits and action levels

54 The control limits to be used depend upon the type of asbestos which is present. The limits are more stringent when amphibole asbestos (eg amosite or crocidolite) are present, either alone or as mixtures of amphiboles or amphiboles with chrystotile. For each of the two categories (with and without amphibole asbestos) there are two limits:

one is a limit on the average fibre level over any continuous 4-hour period, and the other is a limit on the average fibre level over any continuous 10-minute period. Each is a control limit in its own right. If either is exceeded, then suitable RPE is required under regulation 8, and respirator zones must be designated, under regulation 14 of the Control of Asbestos at Work Regulations.[17]

55 The control limits as defined in the Regulations are:

(a) for chrysotile:
  (i) 0.3 fibres per millilitre of air averaged over any continuous period of 4 hours;
  (ii) 0.9 fibres per millilitre of air averaged over any continuous period of 10 minutes;

(b) for any other form of asbestos either alone or in mixtures including mixtures of chrysotile with any other form of asbestos:
  (i) 0.2 fibres per millilitre of air averaged over any continuous period of 4 hours;
  (ii) 0.6 fibres per millilitre of air averaged over any continuous period of 10 minutes.

Employers may choose to assume that the asbestos is not chrysotile alone and apply the more stringent limits; they do not then need to identify the type of asbestos.

56 The action levels apply to exposure in the longer term. They are specified as cumulative exposures within any continuous 12-week period. Cumulative exposure is calculated by multiplying each airborne fibre level by the time for which it lasts and adding up all these products over the 12-week period in question. If the exposure of any employee exceeds an action level, then the regulations on notification,

designated areas and medical surveillance apply (regulations 6,14 and 16 respectively).

57 The action levels are:

(a) where the exposure is solely to chrysotile, 72 fibre-hours per millilitre of air; or

(b) where the exposure is to any other form of asbestos whether alone or in mixtures including mixtures of chryostile with any other form of asbestos, 48 fibre-hours per millilitre of air; or

(c) where both types of exposure occur separately during the 12-week period concerned, a proportionate number of fibre-hours per millilitre of air.

58 The composite limit at (c) above applies only when the two types of exposure occur at different times within the 12-week period; if both types of asbestos are present simultaneously the mixture must be treated as if it were not chrysotile alone.

Lead

The occupational exposure limits for lead
59 The occupational exposure limits for lead are set out in the Control of Lead at Work Regulations 2002 (CLAW).[23]

60 The limits are 8-hour TWA concentrations as follows:

(a) in relation to lead other than lead alkyls, a concentration of lead in the atmosphere to which any employee is exposed of 0.15 mg.m-3; and

(b) in relation to lead alkyls, a concentration of lead in the atmosphere to which any employee is exposed of 0.10mg.m^{-3}.

When determining lead-in-air concentrations for comparison with the occupational exposure limits, the method referred to in regulation 9 of CLAW and described in *Control of lead at work. Control of Lead at Work Regulations 2002. Approved Code of Practice and guidance* [24] should be used.

61 Unlike the former lead-in-air standards which could be exceeded in certain specified circumstances, the exposure limits for lead are ceiling limits which must not be exceeded when calculated as time-weighted averages over 8 hours.

62 As far as exposure by inhalation is concerned, control is considered adequate when exposure does not exceed the appropriate exposure limit. It should be remembered that other routes of exposure to lead are also important, eg ingestion, or contact with the skin where there is exposure to lead alkyls.

The biological limits for lead
63 The CLAW Regulations also contain biological limits as additional measures designed to control employees' exposure to lead. For employees exposed to inorganic lead, the limits are based on the concentration of lead in the blood and expressed as micrograms of lead per decilitre of blood (µg/dl). For employees exposed to lead alkyls, the limits are based on the concentration of lead in urine and the values expressed in units of µg Pb/g creatinine.

Action levels:
64 Where the blood-lead concentration for any employee reaches or exceeds the action level, the employer has a statutory duty to determine why and, so far as is reasonably practicable, to take steps to reduce the employee's blood-lead to below

the action level. The action levels are:

(a) in respect of a woman of reproductive capacity, 25 µg/dl;

(b) in respect of a young person (aged under 18), 40 µg/dl;

(c) in respect of any other employee, 50 µg/dl.

There are no action levels for work involving exposure to lead alkyls.

65 The purpose of the action level is to give the employer early warning that an employee's blood-level concentration is approaching the suspension level so that steps can be taken to prevent it being triggered.

Suspension levels:

66 When the blood-lead (for employees exposed to inorganic lead) or urinary lead (for employees exposed to lead alkyls) concentration of any employee reaches or exceeds the suspension level, the employer will normally remove the employee from work involving further exposure to lead in order to protect the employee's health. The suspension levels are:

(a) a blood-level concentration of:
   (i) in respect of a woman of reproductive capacity, 30 µg/dl;
   (ii) in respect of a young person (aged under 18), 50 µg/dl;
   (iii) in respect of any other employee, 60 µg/dl; or

(b) urinary lead concentration of:
   (i) in respect of a woman of reproductive capacity, 25 µg Pb/g creatinine (14 µmol/mol creatinine);
   (ii) in respect of any other employee, 110 µg Pb/g creatinine (55 µmol/mol creatinine).

67 The employer will only allow the employee to resume work involving exposure to lead when the doctor responsible for carrying out medical surveillance on the employee concerned confirms that the employee's blood or urinary lead concentration has dropped back below the suspension levels.

Substances that can cause occupational asthma

68 Substances that can cause occupational asthma (also known as asthmagens and respiratory sensitisers) can induce a state of specific airway hyper-responsiveness via an immunological, irritant or other mechanism. Once the airways have become hyper-responsive, further exposure to the substance, sometimes even to tiny quantities, may cause respiratory symptoms. These symptoms can range in severity from a runny nose to asthma. Not all workers who are exposed to a sensitiser will become hyper-responsive and it is impossible to identify in advance those who are likely to become hyper-responsive. Substances that can cause occupational asthma are classified under the *Chemicals (Hazard Information and Packaging for Supply) Regulations (CHIP)*[16] and assigned the risk phrase 'R42 May cause sensitisation by inhalation' or 'R42/43 May cause sensitisation by inhalation and skin contact' in the *Approved supply list*.[12]

69 Substances that can cause occupational asthma should be distinguished from substances which may trigger the symptoms of asthma in people with pre-existing airway hyper-responsiveness, but which do not include the disease themselves. The latter substances are not classified asthmagens or respiratory sensitisers.

70 Wherever it is reasonably practicable, exposure to substances that can cause occupational asthma should be prevented. Where this is not possible, the primary

aim is to apply adequate standards of control to prevent workers from becoming hyper-responsive. For substances that can cause occupational asthma, COSHH requires that exposure be reduced as low as is reasonably practicable. Activities giving rise to short-term peak concentrations should receive particular attention when risk management is being considered. Health surveillance is appropriate for all employees exposed or liable to be exposed to a substance which may cause occupational asthma and there should be appropriate consultation with an occupational health professional over the degree of risk and level of surveillance.

71 The 'Sen' notation in the list of WELs has been assigned only to those substances which may cause occupational asthma in the categories shown in Table 1 (see page 12). It should be remembered that other substances not in these tables may cause occupational asthma.

72 HSE's asthma web pages (http://www.hse.gov.uk/asthma) provide information about:

(a) the main causes of occupational asthma;
(b) what it is like to get the disease;
(c) what employers have to do to protect their employees; and
(d) what HSE and stakeholders are doing to tackle the problem.

73 A number of HSE publications provide additional advice on substances which may cause occupational asthma and their control in the workplace. *Preventing asthma at work: How to control respiratory sensitisers*[25] provides step-by-step advice on strategies which can be adopted for preventing or adequately controlling exposure to these asthmagens. *Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma*[4] includes substances which, on the balance of evidence, should not be considered to be asthmagens as well as those that should. Further information on health surveillance can be found in MS25 *Medical aspects of occupational asthma*.[26]

Asphyxiants

74 Some gases and vapours, when present at high concentrations in air, act as simple asphyxiants by reducing the oxygen content by dilution to such an extent that life cannot be supported. Many asphyxiants are odourless and colourless and not readily detectable. Monitoring the oxygen content of the air is often the best means of ensuring safety. There are substantial risks if the concentration of oxygen in the atmosphere varies from normal (20.8%) under normal atmospheric pressure. With reference to specific statutory requirements, any difference in oxygen content from normal should be investigated, the risks assessed, and appropriate measures taken in the light of the risk. In particular, the *Mines and Quarries Act 1954*[27] (Section 55) refer to the duty upon the manager of every mine to secure ventilation below ground adequate for diluting gases and providing air containing sufficient oxygen. Section 55(2)(b) specifies the amount of oxygen in the general body of the air as not less than 19% by volume.

75 Particular care is necessary when dense asphyxiants, eg argon, are used since localised very high concentrations can arise due to their collecting in pits, confined spaces and other low-lying areas where ventilation is likely to be poor.

76 Many asphyxiants present a fire or explosion risk. The concentrations at which these risks can arise are liable to be well below those at which asphyxiation is likely to occur and should be taken into account when assessing the hazards.

Pesticides

77 Substances used as active ingredients in pesticides are listed under their systematic chemical names and/or their (ISO) common names. These may

sometimes be used as parts of the names of proprietary pesticide formulations. In all cases the exposure limit applies to the specific active ingredient in the workplace atmosphere and not the formulation as a whole.

Exposure in mines

78 The control of dust below ground in coal mines is covered by section 74 of the *Mines and Quarries Act 1954*[27] which requires the manager of a coal mine to minimise the 'giving off' of injurious dust below ground and the *Coal Mines (Respirable Dust) Regulations 1975*[28] which cover the respirable fraction of total inhalable dust.

79 By Autumn 2005, a new set of regulations, are expected to be introduced to govern the control of inhalable dust below ground in coal mines. *The Coal Mines (Control of Inhalable Dust) Regulations*, will be announced on the HSE website.

Setting exposure limits

Legal background to exposure limits

80 HSC has established WELs for a number of substances hazardous to health. These are intended to prevent excessive exposure to specified hazardous substances by containing exposure below a set limit. A WEL is the maximum concentration of an airborne substance averaged over a reference period, to which employees may be exposed by inhalation.

Approach to deriving the workplace exposure limit

81 The first stage in the derivation of the WEL involves an assessment of the toxicology of the substance concerned. The purpose of this assessment is to identify the potential for a substance to produce adverse human health effects and to understand the exposure-response relationships for these effects. In the context of OEL-setting, there are certain key reference points on the exposure-response curve. These are the 'No-Observed Adverse Effect Level' (NOAEL) and the 'Lowest-Observed Adverse Effect Level' (LOAEL). The concept of NOAELs/LOAELs is generally agreed to have practical relevance in the OEL-setting context only for those substances or toxicological mechanisms that have a 'threshold' of effect. For example, eye irritation caused by an acid vapour will only occur above a certain threshold exposure concentration, and thus the concept of a NOAEL will apply. In contrast, for substances such as DNA-reactive chemicals that cause cancer by a genotoxic mechanism, although in theory a threshold may exist, (because of biochemical defence and repair mechanisms) currently available techniques do not allow the reliable identification of a clear threshold or NOAEL. (The NOAEL is the highest point on the exposure-response curve at which no adverse health effects are observed; the LOAEL is the lowest point on the exposure-response curve at which adverse health effects are observed).

82 If a NOAEL (or LOAEL) can be identified, then this value is taken as a starting point for estimating the highest level of occupational exposure at which no adverse health effects would be expected to occur in workers or their progeny following exposure over a working lifetime. Given that in many cases, NOAELs/LOAELs are obtained from studies in animals, numerical 'uncertainty factors' (sometimes referred to as 'safety factors') are usually applied in order to arrive at this estimated desired level of exposure. These factors are applied to take account of toxicological uncertainties such as possible species differences in response, and also to take account of human variability in responsiveness.

83 An across-government initiative has examined the ways in which different government departments and agencies deal with toxicological uncertainty in risk assessment and standard-setting procedures.[29] The results of this work can be accessed at http://www.le.ac.uk/ieh/pdf/cr9.pdf. In the light of this information ACTS and its scientific subcommittee may develop a more formalised approach on the use of uncertainty factors for setting WELs.

84 Having determined the highest level of occupational exposure at which no adverse health effects would be predicted to occur, the next stage is to determine whether this level of exposure is currently being achieved in the workplace. If not, then consideration would be given to the potential for improving existing standards of control such that this level of exposure could be reasonably achieved. If ACTS consider this level of exposure is reasonably practicable, then the WEL will be proposed at this level.

85 This route to deriving the WEL will result in a limit set at a level at which no adverse health effects would be expected to occur in workers or their progeny, based on the known and/or predicted effects of the substance, and would also be reasonably practicable for industry to achieve.

86 There are some categories of substance for which this route to deriving a WEL, based on the concept of a NOAEL/LOAEL will not be possible:

(a) Genotoxic carcinogens: For such substances, there are no currently available techniques by which it is generally accepted that a NOAEL can be reliably identified; hence an approach based on a NOAEL cannot be applied.

(b) Asthmagens: although the concept of a NOAEL may be valid, the quality of the available data means that it is generally not possible to identify a threshold level of occupational exposure below which there would be no risk of developing the disease;

(c) Mixtures of variable composition such as metalworking fluids (MWFs): The variable composition means that MWFs pose a variable hazard. A defined position on the likely human health effects and the identification of single NOAEL value is not possible;

(d) Any other substance for which the balance of doubt and uncertainty about likely human health effects is such that a NOAEL or threshold for effect cannot be confidently identified or predicted. This is more likely to apply to substances with inadequate toxicity data-sets. What is meant by an ‘adequate data-set’, particularly in the context of OEL-setting, is difficult to define, as it varies according to the nature of the substance, and other factors such as the ability to ‘read-across’ to data-sets on similar substances. Expert judgement on a case-by-case basis will be needed to determine whether a particular data-set is adequate to predict health effects confidently;

(e) For some substances, a NOAEL/LOAEL may be identifiable from which it is possible to estimate a level of exposure at which no adverse human health effects would be predicted to occur. However, after due consideration of the costs and efficacy of available control solutions, ACTS may consider that it would not be reasonably practical to control below this desired level of exposure across all industry sectors.

87 For substances belonging in one of the above categories (a)-(e), the WEL would be derived by identifying a level of exposure which would represent a standard of control commensurate with good occupational hygiene practice. In determining this level, the severity of the likely health effects, and the cost and efficacy of control solutions would have to be taken into account. Agreement on what represents a good standard of control will be for ACTS and its scientific subcommittee, informed by:

(a) knowledge of the standards of control currently being achieved in different industry sectors using the substance;

(b) the potential for improving standards; and

(c) the potential health impact of the substance.

88 For example, a good standard of control for a non-reactive dust such as titanium dioxide would not be considered adequate for a cytotoxic dust such as cyclophosphamide. For substances that have had little or no safety testing, for which the potential health hazards are highly uncertain, good practice would dictate the need for an increased stringency of control as a precautionary measure.

The process of deriving the value of the WEL would be an iterative one, involving comparisons of the costs of achieving successively lower proposed WEL values against the estimated health benefits until agreement on an appropriate value is reached. The arguments and rationale for each substance would be set out in Regulatory Impact Assessment documents. In relation to this proposed route to OEL-setting, as far as possible, the WEL would **not** be set at a level at which there is positive evidence of adverse effects on human health.

89 A diagrammatic summary of the proposed OEL-setting process is presented as Figure 1 (below).

Criteria for setting workplace exposure limits

90 WELs are derived by the following criteria:

(a) the WEL value would be set at a level at which no adverse effects on human health would be expected to occur based on the known and/or predicted effects of the substance. However, if such a level cannot be identified with reasonable confidence (categories (a)-(d) in paragraph 86), or if this level is not reasonably achievable (category (e) in paragraph 86); then,

(b) the WEL value would be based at a level corresponding to what is considered to represent good control, taking into account the severity of the likely health hazards and the costs and efficacy of control solutions. Wherever possible, the WEL would not be set at a level at which there is evidence of adverse effects on human health.

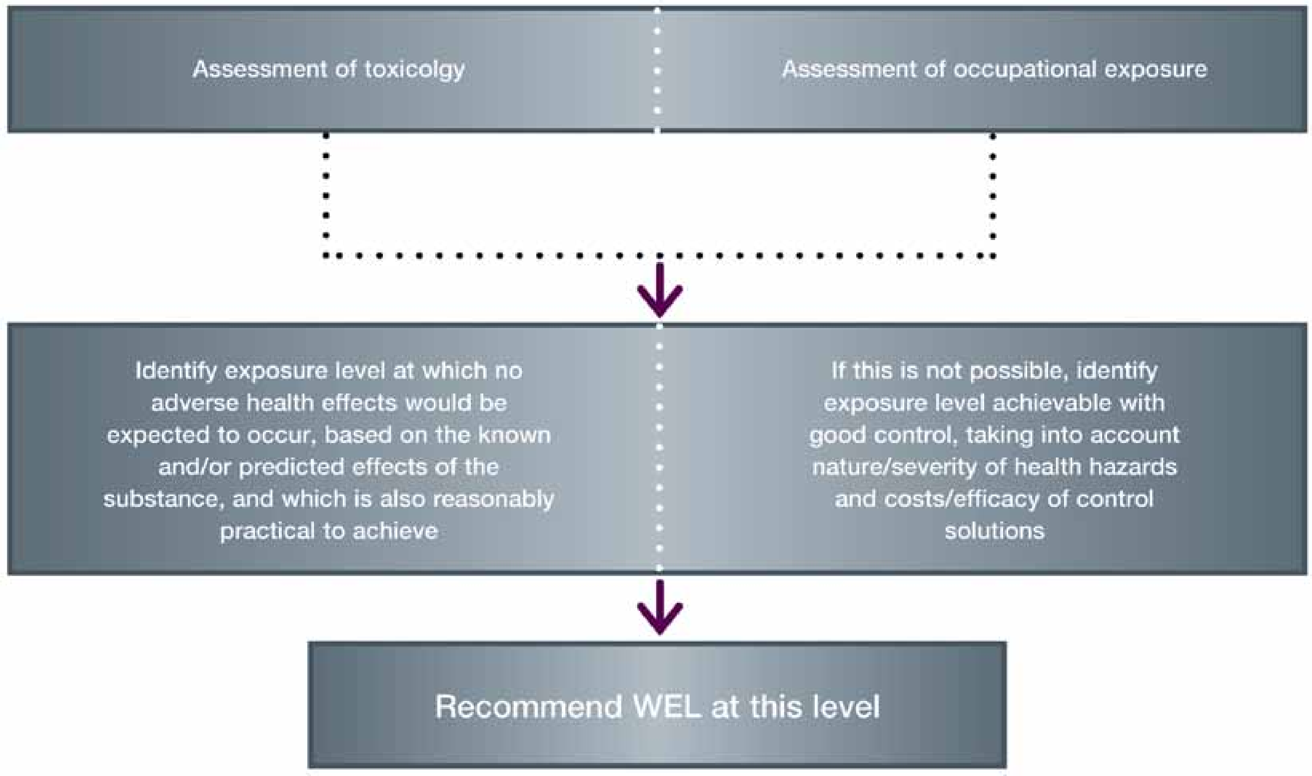

Figure 1 Summary of WEL-setting process

Applying occupational exposure limits

Scope of the limits

91 The list of WELs, unless otherwise stated, relates to personal exposure to substances hazardous to health in the air of the workplace. The limits cannot be adapted readily to evaluate or control non-occupational exposure, eg levels of contamination in the neighbourhood close to an industrial plant. WELs are approved only for application to people at work. Employers should also take into account their duties under the Environmental Protection Act (see http://www.environment-agency.gov.uk).[30] WELs are approved only for use where the atmospheric pressure is between 900 and 1100 millibars. This covers the normal range of meterological variations in Great Britain and slightly pressurised workplaces such as clean rooms, but not the hyperbaric conditions which may be encountered in, for example, tunneling or diving. To enable WELs to be applied in hyperbaric conditions the limits should be expressed as a partial pressure or mass/volume concentration at higher pressures. This approach has been endorsed by the Advisory Committee on Toxic Substances (ACTS) and is discussed in detail in EH75/2 *Occupational exposure limits for hyperbaric conditions*.[31]

92 Workplace exposure limits as set out in regulation 7 of COSHH, are intended to be used for normal working conditions in factories or other workplaces. Over and above their responsibilities to ensure that the requirements of COSHH are met, employers also have a clear responsibility to ensure that the plant is designed, operated and maintained in a way that avoids accidents and emergencies. Where appropriate, detection, alarm and response measures should be used in order to minimise the effect of any such unplanned events.

Long-term and short-term exposure limits

93 Effects of exposure to substances hazardous to health vary considerably depending on the nature of the substance and the pattern of exposure. Some effects require prolonged or accumulated exposure. The **long-term (8-hour TWA) exposure limit** is intended to control such effects by restricting the total intake by inhalation over one or more workshifts, depending on the length of the shift. Other effects may be seen after brief exposures. **Short-term exposure limits (usually 15 minutes)** may be applied to control these effects. For those substances for which no short-term limit is specified it is recommended that a figure of three times the long-term limit be used as a guideline for controlling short-term peaks in exposure. Some workplace activities give rise to frequent short (less than 15 minutes) periods of high exposure which, if averaged over time, do not exceed either an 8-hour TWA or a 15-minute TWA. Such exposures have the potential to cause harm and should be subject to reasonably practicable means of control unless a ‘suitable and sufficient’ risk assessment shows no risk to health from such exposures.

94 In some situations such as in submarines and saturation diving the occupational exposure is essentially continuous. In these cases a continuous exposure limit should be derived by dividing the 8-hour TWA exposure limit by a factor of 5. This approach has been endorsed by ACTS and is discussed in detail in EH75/2 *Occupational exposure limits for hyperbaric conditions*.[31]

95 Both the long-term and short-term exposure limits are expressed as airborne concentrations averaged over a specified period of time. The period for the long-term limit is normally eight hours, when a different period is used this is stated. The averaging period for the short-term exposure limit is normally 15 minutes, such a limit applying to any 15-minute period throughout the working shift. Exposure to substances hazardous to health should be calculated according to the approved method, which is reproduced on pages 49-52.

Help in applying limits

COSHH essentials

96 HSE's guidance *COSHH essentials*[2] provides advice to employers on fulfilling a legal duty under COSHH to control exposures to chemicals hazardous to health. It uses a step-by-step process for identifying the right controls to reduce exposure for many hazardous substances, and control guidance sheets which apply to common situations, eg mixing, weighing, surface coating. In order to choose the correct control approach (general ventilation, engineering control, containment or special) the following factors are considered:

(a) the possible health effects from exposure to a chemical. These are determined by the Risk Phrase for a substance (Table 1 includes a list of R-phrases). *COSHH essentials*[2] divides chemicals into five hazard bands. These range from A (least hazardous) through to E (most hazardous) with an additional band, S, which is used for substances that cause damage if they come into contact with the skin or eyes;

(b) the amount of a chemical in use; and

(c) its dustiness or volatility.

97 Once the general control approach is determined, more detailed advice can be found in dedicated control guidance sheets which cover a wide range of tasks.

98 The *COSHH essentials*[2] website (http://www.coshh-essentials.org.uk) now also provides direct advice for a number of tasks and processes in the production and service industries. This allows users to obtain advice without having to go through the assessment route. HSE plans to add further direct advice sheets to *COSHH essentials*.

99 For people who want more technical information to help them apply the scheme to hazards or situations, a summary of the technical basis for *COSHH essentials*[2] is available at http://www.coshh-essentials.org.uk/assets/live/CETB.pdf.

Units of measurement

100 In workplace exposure limits, concentrations of airborne particles (fume, dust etc) are usually expressed in mg.m-3. In the case of dusts, the limits in the table refer to the 'inhalable' fraction unless specifically indicated as referring to the 'respirable' fraction (see paragraphs 42-45 on page 35). Exceptionally, the limits for MMMFs and for RCFs can be expressed either as $mg.m^{-3}$ or as fibres per millilitre of air ($fibres.ml^{-1}$) (see paragraphs 50-58 on pages 37-38 for asbestos). Workplace exposure limits for volatile substances are usually expressed in both parts per million by volume (ppm) and milligrams per cubic metre ($mg.m^{-3}$). For these substances, limits are set in ppm, and a conversion to $mg.m^{-3}$ is calculated. The value in $mg.m^{-3}$ for a given concentration in ppm depends on the temperature and pressure of the ambient air, which in reality vary over time. Therefore conversion calculations are based on a standard set of typical conditions.

Conversion and rounding of WELS expressed in ppm to $mg.m^{-3}$

101 The limits in Table 1 have been calculated from first principles, using the following method.

$$\text{WEL in mg.m}^{-3} = \frac{\text{WEL in ppm x MWt}}{24.05526}$$

where MWt is the molecular weight (molar mass in $g.mol^{-1}$) of the substance.

Note that 24.05526 $l.mol^{-1}$ is the molar volume of an ideal gas at 20ºC and 1 atmosphere pressure (760 mm mercury, 101325 Pa, 1.01325 bar).

102 The results have been rounded using the following procedure:

Range containing the newly calculated WEL (in $mg.m^{-3}$)	Round to:
Less than 0.1	1 significant figure
0.1 to less than 100	2 significant figures
100 or over	3 significant figures

Calculation of exposure

103 Exposure to substances hazardous to health should be calculated according to the approved method. The calculated exposure should then be compared with the workplace exposure limits for that substance for the purposes of determining compliance with COSHH, regulation 7. Where a WEL is listed both for a long-term reference period and a short-term reference period it will be necessary to compare the calculated exposures appropriately with both workplace exposure limits.

Limitations to the application of exposure limits

104 The exposure limits relate to personal monitoring.

Other factors

105 Working conditions which impose additional stress on the body, such as exposure to ultra-violet radiation, high temperatures, pressures and humidity, may increase the toxic response to a substance. In such cases specialist advice may be necessary to evaluate the effects of these factors.

Absorption through the skin

106 For most substances, the main route of entry into the body is by inhalation and the exposure limits given in this booklet relate solely to exposure by this route. However, some substances have the ability to penetrate intact skin and become absorbed into the body, thus contributing to systemic toxicity; these substances are marked in the table with an ‘Sk’ notation. ACTS has agreed the following criteria for assigning this notation:

(a) The ‘Sk’ notation is assigned in cases where the available data or experience (or predictions made in the absence of actual data) suggest that exposure via the dermal route may:

(i) make a substantial contribution to body burden (when compared to the contribution attributable to inhalation exposure at the WEL); and

(ii) cause systemic effects, so that conclusions about exposure and health effects based solely on airborne concentration limits may be incomplete.

107 Absorption through the skin can result from localised contamination, for example from a splash on the skin or clothing, or in certain cases from exposure to high atmospheric concentrations of vapour. This may result in a substantial body burden, so that serious effects may result with little or no warning. It is necessary to take special precautions to prevent skin contact when handling these substances. Where the 'Sk' notation has been assigned and the methods of use provide a potential exposure route via skin absorption these factors should be taken into account in determining the adequacy of the control measures. Further guidance is given on the adequate control of exposure by routes other than inhalation in the *COSHH ACOP*,[5] in *The safe use of pesticides for non-agricultural purposes*[32] and *Code of practice for the safe use of pesticides on farms and holdings*.[33]

Calculation methods

Calculation of exposure with regard to the specified reference periods

108 This section reproduces the approved methods for the calculation of exposure in relation to the 8-hour, short-term and one-year reference periods. **These methods are legally binding because they have been approved by the Health and Safety Commission.**

Notice of approval

The Health and Safety Commission has on 9 November 2004 approved the methods of calculation set out in the Schedule to this Notice for the purpose of determining exposure in relation to the reference periods for workplace exposure limits as specified in regulation 2(1) of the Control of Substances Hazardous to Health Regulations 2002 (as amended) and occupational exposure limit for lead as specified in Regulation 2(1) of the Control of Lead at Work Regulations 2002.

Signed
SUSAN MAWER
Secretary to the Health and Safety Commission
9 November 2004

Schedule

Part 1 The 8-hour reference period

1 The term '8-hour reference period' relates to the procedure whereby the occupational exposures in any 24-hour period are treated as equivalent to a single uniform exposure for 8 hours (the 8-hour time-weighted average (TWA) exposure).

2 The 8-hour TWA may be represented mathematically by:

$$\frac{C_1T_1+C_2T_2+\ldots C_nT_n}{8}$$

where C_1 is the occupational exposure and T_1 is the associated exposure time in hours in any 24-hour period.

Example 1

3 The operator works for 7 hours 20 minutes on a process in which he is exposed to a substance hazardous to health. The average exposure during that period is measured as 0.12 mg.m^{-3}.

The 8-hour TWA =

7 h 20 min (7.33 h) at 0.12 mg.m^{-3}
40 min (0.67 h) at 0 mg.m^{-3}

That is

$$\frac{(0.12 \times 7.33) + (0 \times 0.67)}{8}$$

$$= 0.11 \text{ mg.m}^{-3}$$

Example 2

4 The operator works for eight hours on a process in which he is exposed to a substance hazardous to health. The average exposure during that period is measured as 0.15 $mg.m^{-3}$.

The 8-hour TWA =

$$\frac{(0.15 \times 8)}{8}$$

$$= 0.15\ mg.m^{-3}$$

Example 3

5 Working periods may be split into several sessions for the purpose of sampling to take account of rest and meal breaks etc. This is illustrated by the following example:

Working period	**Exposure ($mg.m^{-3}$)**	**Duration of sampling (h)**
0800-1030	0.32	2.5
1045-1245	0.07	2
1330-1530	0.2	2
1545-1715	0.1	1.5

Exposure is assumed to be zero during the periods 1030 to 1045, 1245 to 1330 and 1530 to 1545.

The 8-hour TWA =

$$\frac{(0.32 \times 2.5) + (0.07 \times 2) + (0.20 \times 2) + (0.10 \times 1.5) + (0 \times 1.25)}{8}$$

$$\frac{0.80 + 0.14 + 0.40 + 0.15 + 0}{8}$$

$$= 0.19\ mg.m^{-3}$$

Example 4

6 An operator works for eight hours during the night shift on a process in which he is intermittently exposed to a substance hazardous to health. The operator's work pattern during the working period should be known and the best available data relating to each period of exposure should be applied in calculating the 8-hour TWA. These should be based on direct measurement, estimates based on data already available or reasonable assumptions.

Working period	**Task**	**Exposure (mg.m-3)**
2200 to 2400	Helping in workshop	0.1 (known to be exposure of full-time group in workshop)
2400 to 0100	Cleaning elsewhere in factory	0 (assumed)
0100 to 0400	Working in canteen	0 (assumed)
0400 to 0600	Cleaning-up after breakdown in workshop	0.21 measured

The 8-hour TWA =

$$\frac{(0.10 \times 2) + (0.21 \times 2) + (0 \times 4)}{8}$$

$= 0.078\ \text{mg.m}^{-3}$

Example 5
7 The operator works a 12-hour shift each day for five days, and then has seven days' rest. The exposure limits are based on an 8-hour reference period in each 24 hours in which an exposure occurs; the seven days' rest makes no difference. While at work, the operator is exposed to 4 mg.m^{-3}.

The 8-hour TWA =

$$\frac{(4 \times 12)}{8}$$

$= 6\ \text{mg.m}^{-3}$

The short-term reference period

8 Exposure should be recorded as the average over the specified short-term reference period, normally 15 minutes, and should be determined by sampling over that period. For short emissions of less than the reference period, which still may have the potential to cause harm, appropriate action should be taken to ensure that a 'suitable and sufficient' risk assessment is carried out to ensure that there is no risk to health from such exposures.

Methods of measurement and calculation for determining the fibre concentrations of MMMF

109 These paragraphs reproduce the Notice of Approval which is based on the methods detailed in MDHS59 *Man-made mineral fibre*.[34] **The methods are legally binding because they have been approved by the Health and Safety Commission.**

Notice of approval

The Health and Safety Commission has on 9 November 2004 approved the methods of measurement and calculation set out in the Schedule to this notice for the purpose of determining the fibre concentration of MMMF (also known as man-made mineral fibres, machine-made mineral fibres and man-made vitreous fibres) in air for comparison with the workplace exposure limit specified in the Health and Safety Commission's approved list of workplace exposure limits.

Signed:
SUSAN MAWER
Secretary to the Health and Safety Commission
9 November 2004

Schedule

1 The method shall measure the exposure of employees by sampling in the breathing zone of the employee exposed.

2 ‘Fibre’ means a particle with a length >5 μm, average diameter <3 μm, and a ratio of length to diameter >3 to 1, which can be seen using the system specified in paragraph 3.

3 Fibres shall be counted with a phase contrast microscope of such a quality and maintained in such condition at all times during the use that Block 5 on the HSE/NPL Test Slide Mark II would be visible when used in accordance with the manufacturer’s instructions. The microscope shall be tested with the Slide frequently enough to establish this. The microscope magnification shall be between 400x and 600x. During counting, the difference in refractive index between the fibres and the medium in which they are immersed shall be between 0.05 and 0.30. The microscopist shall be properly trained in relevant techniques.

4 The results shall be regularly tested by quality assurance procedures to ensure that the results are in satisfactory agreement with the average of results obtained by British laboratories participating in a national quality assurance scheme using the methods specified in paragraphs 1-3.

Monitoring exposure

110 Regulation 10 of COSHH imposes a duty to monitor the exposure of employees to substances hazardous to health in certain specified situations. Further advice on these requirements may be found in the guidance on monitoring of exposure in the COSHH ACOP.[5]

Personal/workplace air monitoring

111 Sampling strategies may involve measurement of the hazardous substance in the breathing zone of the worker (personal sampling) or in the workplace air. Details of routine sampling strategies for individual substances are outside the scope of this document. However, advice is available in *Monitoring strategies for toxic substances*[6] which provides practical guidance on monitoring substances hazardous to health in air.

112 Methods for the sampling and analysis of many substances which have been assigned WELs are described in the HSE series 'Methods for the Determination of Hazardous Substances' (MDHS). The series also incorporates publications of a more general nature such as method validation protocols and guidance on analytical quality assessment and control.

113 HSE also operates an external quality assessment or proficiency testing scheme for the analysis of a range of common substances in workplace air. Details of the WASP scheme (Workplace Analysis Scheme for Proficiency), which is administered by HSE's Health and Safety Laboratory, are available through the HSE Information Centre (see paragraph 16).

Biological monitoring (see also Table 2, page 27)

114 Biological monitoring can be a very useful complementary technique to air monitoring when air sampling techniques alone may not give a reliable indication of exposure. Biological monitoring is the measurement and assessment of hazardous substances or their metabolites in tissues, secretions, excreta or expired air, or any combination of these, in exposed workers. Measurements reflect absorption of a substance by all routes. Biological monitoring may be particularly useful in circumstances where there is likely to be significant skin absorption and/or gastrointestinal tract uptake following ingestion; where control of exposure depends on respiratory protective equipment; where there is a reasonably well-defined rela~~tionshi~~p between biol~~ogica~~l monitoring~~ and~~ effect; or w~~here~~ it gives information on accumulated dose and target organ body burden which is related to toxicity.

115 Biological Monitoring Guidance Values (BMGVs) are set where they are likely to be of practical value, suitable monitoring methods exist and there are sufficient data available. The type of data that are available will vary between substances and therefore the route taken to deriving the BMGV will vary between substances. BMGVs are either based on a relationship between biological concentrations and health effects, between biological concentrations and exposure at the level of the WEL or are based on data collected from a representative sample of workplaces correctly applying the principles of good occupational hygiene practice. The technical basis for each BMGV will be clearly described in supporting documentation such as an EH64 summary or other guidance.

116 BMGVs are non-statutory and any biological monitoring undertaken in association with a guidance value needs to be conducted on a voluntary basis

(ie with the fully informed consent of all concerned). BMGVs are intended to be used as tools in meeting the employer's primary duty to ensure adequate control under COSHH. Where a BMGV is exceeded it does not necessarily mean that any corresponding airborne standard has been exceeded nor that ill health will occur. It is intended that where they are exceeded this will give an indication that investigation into current control measures and work practices is necessary. Of course, that is not necessarily to say that because biological monitoring results are below a particular guidance value an employer need take no further action to reduce exposure. But it should be noted that BMGVs are not an alternative or replacement for airborne occupational exposure limits. Further guidance can be found in *Biological monitoring in the workplace*.[35]

Mixed exposures

WELs for mixtures

117 The majority of WELs listed in EH40 are for single compounds or for substances containing a common element or radical, for example, ‘tungsten and compounds’, and ‘isocyanates’. A few of the WELs relate to substances commonly encountered as complex mixtures or compounds, for example ‘rubber fume’. The WELs for complex mixtures such as rubber fume and hydrocarbon solvents (see paragraph 118) are without prejudice to any WELs for individual components. If the Safety Data Sheet lists a substance with a WEL, the employer should ensure that the WEL is not exceeded. If the substance is one to which a ‘Carc’ or ‘Sen’ notation has been applied or which is assigned one of the risk phrases R42, R42/43, R45, R46, R49, or is listed in Schedule 1 of the COSHH Regulations, or in section C of *Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma*, or is a substance which the risk assessment has shown to be a potential cause of occupational asthma there is a requirement to reduce exposure as low as is reasonably practicable. This requirement applies regardless of whether or not the substance has a WEL.

Hydrocarbon solvents

118 Hydrocarbon solvents are normally supplied as complex mixtures. To assist producers and suppliers of mixed hydrocarbon blends to determine suitable ‘in house’ OELs, ACTS recommend the procedure detailed in paragraphs 119-121. The supplier may pass this information on to a customer, and should in that case refer to this guidance. The procedure covers aliphatics in the range C_5 to C_{15}, cycloalkanes in the range C_5 to C_{16} and aromatics. This definition does not include halogenated or oxygenated hydrocarbons. The procedure only applies to vapours; mists are excluded.

Reciprocal calculation procedure for mixtures of hydrocarbon solvents

119 ‘In-house’ OELs are derived using the reciprocal calculation procedure (RCP). Thus the OEL for a mixture is calculated as follows:

$$\frac{1}{OEL_{sol}} = \frac{FR_a}{OEL_a} + \frac{FR_b}{OEL_b} + \frac{FR_n}{OEL_n}$$

Where:

OEL_{sol} = occupational exposure limit of the hydrocarbon solvent mixture (in $mg.m^{-3}$)

OEL_a = occupational exposure limit or guidance value of the component ‘a’ (in $mg.m^{-3}$)

FR_a = fraction (w/w) of component ‘a’ in the solvent mixture

The OEL_{sol} obtained should be rounded to the nearest number as follows:

OEL_{sol}	<100 $mg.m^{-3}$	nearest 25
	100-600 $mg.m^{-3}$	nearest 50
	>600 $mg.m^{-3}$	nearest 200

120 The RCP requires an OEL for each component in a mixture of hydrocarbons. Since for many individual hydrocarbons the data on which an OEL could be based is limited, ACTS agreed to:

(a) divide hydrocarbons into discrete groups based on structural similarity and critical health effects;

(b) exclude from these groups hydrocarbons with specific toxicity concerns (eg n-hexane). For these hydrocarbons WELs are listed in Table 1. These WELs should be used in the RCP;

(c) assign guidance values to these groups which can then be used in the RCP. It should be noted that guidance values have no legal status and there is no obligation on industry to comply with these values if they possess data indicating another limit is more appropriate.

The following values (8-hour TWAs) have been approved by ACTS:

Normal and branched chain alkanes

C5 –C6	1800 mg.m^{-3}
>C7	1200 mg.m^{-3}

This group **excludes** n-hexane and n-heptane.

Cycloalkanes

C5 –C6 = 1800 mg.m^{-3}
>C7 = 800 mg.m^{-3}

This group **excludes** cyclohexane.

Aromatics

500 mg.m^{-3}

This group **excludes** benzene, toluene, xylene, (o-, m-, p- or mixed isomers), ethylbenzene, trimethylbenzene (all isomers) and cumene.

Example

121 The following is an example of how the RCP is applied. White spirit typically contains the following percentage of hydrocarbons:

52%	alkanes >C_7 guidance value = 1200 mg.m^{-3}
27%	cycloalkanes >C_7 guidance value = 800 mg.m^{-3}
10%	aromatics guidance value = 500 mg.m^{-3}
1%	C_8 aromatics (o-, m-, p- xylene or mixed isomers) WEL = 220 mg.m^{-3}
10%	trimethylbenzenes WEL = 125 mg.m^{-3}

Using the three guidance values and the WEL values for xylene and trimethybenzenes, an OEL for white spirit can be obtained as shown:

$$\frac{1}{OEL_{sol}} = \frac{52/100}{1200} + \frac{27/100}{800} + \frac{10/10}{500}$$

$$\frac{1/100}{220} + \frac{10/100}{125}$$

$$\frac{1}{OEL_{sol}} = 1.816 \times 10^{-3}$$

$$OEL_{sol} = 551 \text{ mg.m}^{-3}$$

rounded to the nearest 50 gives an OEL for this particular brand of white spirit of 550 mg.m^{-3}.

Effects of mixed exposures

122 In the workplace workers are frequently subject to a variety of mixed exposures involving solid or liquid aerosols or gases. These can arise as a result of work with materials containing a mixture of substances, or from work with several individual substances, simultaneously or successively, in a workshift. Mixed exposures require careful assessment of their health effects and the appropriateness of control standards. The following paragraphs provide a brief summary of the advice on the application of WELs in these circumstances. In all cases of doubt, specialist advice should be sought.

123 The ways in which the constituent substances of a mixed exposure interact vary considerably. Some mixed exposures involve substances that act on different body tissues or organs, or by different toxicological mechanisms, these various effects being independent of each other. Other mixtures will include substances that act on the same organs, or by similar mechanisms, so that the effects reinforce each other and the substances are additive in their effect. In some cases the overall effect is considerably greater than the sum of the individual effects, and is synergistic. This may arise from mutual enhancements of the effects of the constituents or because one substance potentiates another, causing it to act in a way which it would not do alone.

Risk assessment and control

124 With all types of mixed exposures it is essential that assessments should be based on the concentrations of each of the constituents in air to which workers are exposed. Depending on the nature of the constituents and the circumstances of use, the relative concentrations of the constituents in air may differ considerably from those in the liquid or solid source material. The composition of the bulk material should not be relied on for assessment unless there is good evidence for doing so.

125 Where mixed exposures occur, the first step is to ensure adequate control of exposure for each individual substance, as explained in schedule 2A of the COSHH ACOP. WELs for defined mixtures should be used only where they are applicable and in addition to any relevant individual WELs. They should not be extended to inappropriate situations. It is then necessary to assess whether further control is needed to counteract any increased risk from the substances acting in conjunction.

Expert assessments for some particular mixed exposures may be available and can be used as guidelines in similar cases. In other cases, close examination of the toxicological data will be necessary to determine which of the main types of interaction (if any) are likely for the particular combination of substances concerned; the various types should be considered in the following order:

(a) ***Synergistic substances:*** Known cases of synergism and potentiation are considerably less common than the other types of behaviour in mixed exposures. However, they are the most serious in their effects and require the most strict control. They are also the most difficult to assess and wherever there is reason to suspect such intervention, specialist advice should be obtained;

(b) ***Additive substances:*** Where there is reason to believe that the effects of the constituents are additive, and where the WELs are based on the same health effects the mixed exposure should be assessed by means of the formula:

$$C_1/L_1 + C_2/L_2 + C_3/L_3 \ldots < 1$$

where C_1, C_2 etc are the time-weighted average (TWA) concentrations of constituents in air and L_1, L_2 are the corresponding WELs. Where the sum of the C/L fractions does not exceed 1, the exposure is considered not to exceed the notional exposure limit. The use of this formula is only applicable where L_1, L_2 etc relate to the same reference period in the list of approved WELs. This formula is not applicable where the lead health effect is cancer or asthma, ie substances to which a ‘Carc’ or ‘Sen’ notation has been applied or to which one of the risk phrases R42, R42/43, R45, R46, R49 has been assigned, or to substances listed in Schedule 1 of COSHH, or substances that are listed in section C of *Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma*,[4] or substances for which the risk assessment has shown to be a potential cause of occupational asthma. For mixtures containing these substances the overriding duty is to reduce exposure so far as is reasonably practicable (see paragraph 117).

(c) ***Independent substances:*** where no synergistic or additive effects are known or considered likely, the constituents can be regarded as acting independently and the measures needed to achieve adequate control assessed for each separately. The controls needed for the mixture will be those for the component requiring the tightest control.

126 The above steps provide a basic protocol for assessment of mixed exposures. It is open to people responsible for control of exposure to treat all non-synergistic systems as though they were additive. This avoids the need to distinguish additive and independent systems and can be regarded as the more prudent course, particularly where the toxicity data are scarce or difficult to assess.

Monitoring mixed exposure

127 Information on monitoring airborne contaminants is given in *Monitoring strategies for toxic substances*.[6] The number of components of a mixed exposure for which routine air monitoring is required can be reduced if their relative concentrations can be shown to be constant. This involves the selection of a key or marker, which may be one of the constituents, as a measure of the total contamination. Exposure to the marker is controlled at a level selected so that exposures to all components will be controlled in accordance with the criteria in paragraph 125 (a) and (b). However, if one of the components has been assigned a ‘Carc’ or ‘Sen’ notation or one of the risk phrases R42, R42/43, R45, R46,

R49, or is listed in Schedule 1 of the COSHH regulations, or is listed in section C of *Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma*,[4] or is a substance for which the risk assessment has shown to be a potential cause of occupational asthma, then the level of the exposure to that substance should always be reduced so far as is reasonably practicable. Monitoring should be under the guidance of suitable specialist advice.

Complicating factors

128 Several factors that complicate the assessment and control of exposure to individual substances will also affect cases of mixed exposures and will require similar special consideration. Such factors include:
(a) exposure to a substance for which there is no WEL (see Schedule 2A of the COSHH ACOP);[5]

(b) the relevance of such factors as alcohol, medication, smoking and additional stresses;

(c) exposure of the skin to one or more substances that can be absorbed by this route as well as by inhalation (see Schedule 2A of the COSHH ACOP); and

(d) substances in mixtures may mutually affect the extent of their absorption, as well as their health affects, at a given level of exposure.

In each of these circumstances specialist advice should be obtained.

List of synonyms

Substance	*Name it is listed by in Table 1*
α-chloropropylene oxide	1-Chloro-2, 3-epoxypropane (Epichlorohydrin)
(Diethylamine)ethane	Triethylamine
(S)-3-(1-Methyl-2-pyrrolidinyl)pyridine	Nicotine
1-(1-methylethyl)amino-3-(1-naphthalenoxy)propan-2-ol	Propranolol
1,1,1-trifluoro-2,2-chlorobromoethane	Halothane
1,1’-Azobiscarbamide	Azodicarbonamide
1,1’-Azobisformamide	Azodicarbonamide
1,1-Dichloroethylene	Vinylidene chloride
1,1’-Dimethyl-4,4’-Bipyridinium dichloride	Paraquat dichloride (ISO),
1,1-oxybisethane	Diethyl ether
1,2,3,4,7,7-Hexachloro-1,5,5a,6,9,9a-hexahydro-6, 9-methano-2,4,3-benzodioxathiepin-3-oxide	Endosulfan (ISO)
1,2,3-Trimethylbenzene	1,2,3-Trimethylbenzene
Hemi mellitene	Hemi mellitene
1,2,4-Benzenetricarboxylic anhydride	Trimellitic anhydride
1,2,4-TCB	1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene	1,2,4-Trimethylbenzene
Pseudocumene	Pseudocumene
1,2-Benzenedicarboxylic acid dinonyl ester	Dinonyl phthalate
1,2-Benzenedicarboxylic acid, di-2-propenyl ester	Diallyl phthalate
1,2-Benzenedicarboxylic anhydride	Phthalic anhydride
1,2-Benzenediol	Pyrocatechol
1,2-Bis(ethoxycarbonyl)ethyl O,O-dimethyl phosphorodithioate	Malathion (ISO)
1,2-Dichloroethene	1,2-Dichloroethylene, cistrans isomers 60:40
1,2-Dichlorotetrafluoroethane	Cryofluorane (INN)
1,2-Dihydroxybenzene	Pyrocatechol
1,2-Dihydroxyethane	Ethane-1,2-diol
1,2-Dihydroxypropane	Propane-1,2-diol
1,2-Epoxypropane	Propylene oxide
1,2-Ethanediol	Ethane-1,2-diol
1,3,5-Triglycidyl isocyanurate	Triglycidyl isocyanurate (TGIC)
1,3,5-Trimethylbenzene	1,3,5-Trimethylbenzene
Mesitylene	Mesitylene
1,3-Benzenediol	Resorcinol
1,3-Butadiene	Buta-1,3-diene
1,3-Dichloro-5,5-dimethyl-2,4-imidazolidinedione	1,3-Dichloro-5,5-dimethyl-hydantoin
1,3-Diformyl propane	Glutaraldehyde
1,3-Dioxo-5-phthalancarboxylic acid	Trimellitic anhydride
1,3-Dioxophthalan	Phthalic anhydride
1,3-Isobenzofurandione	Phthalic anhydride
1,3-Phthalandione	Phthalic anhydride
1,4,7-Tri-(aza)-heptane	2,2’-Iminodi (ethylamine)
1,4-Benzenediamine	p-Phenylenediamine
1,4-Diaminobenzene	p-Phenylenediamine
1,4-Diazacyclohexane	Piperazine
1,4-Dihydroxybenzene	Hydroquinone
1,4-Epoxybutane	Tetrahydrofuran
1,7,7-Trimethylnorcamphor	Bornan-2-one
1-Amino-2-methylbenzene	o-Toluidine
1-Aminoethane	Ethylamine
1-Chloro-2,2,2-trifluoroethyldifluoromethyl ether	Isoflurane
1-Isopropylamino-3-(1-naphthyloxy)propan-2-ol	Propranolol
1-Methoxy-2-propanol acetate	1-Methoxypropyl acetate

Substance	***Name it is listed by in Table 1***
1-Methoxypropylacetate-2-acetic acid	1-Methoxypropyl acetate
1-Methyl-2-aminobenzene	o-Toluidine
1-methyl-2-pyrrolidinone	1-Methyl-2-pyrrolidone
1-Methylethylbenzene	Cumene
1-pentyl acetate	Pentyl acetates (all isomers)
1-Propyl acetate	n-Propyl acetate
2,2-Bis(hydroxymethyl)-1,3-Propanediol	Pentaerythritol
2,4,6-Trinitrophenol	Picric acid
2,4-DES	Sodium 2-(2,4-dichlorophenoxy) ethyl sulphate
2,4-Dichlorophenoxyacetic acid	2,4-D (ISO)
2,5-Furandione	Maleic anhydride
2-Acetoxybenzoic acid	o-Acetylsalicylic acid
2-Acetoxypropane	Isopropyl acetate
2-Aminopyridine	2-Pyridylamine
2-Aminotoluene	o-Toluidine
2-Bromo-2-chloro-1,1,1-trifluroethane	Halothane
2-Butanone	Butan-2-one (methyl ethyl ketone)
2-Chloro-1,1,2-trifluoroethyldifluoromethyl ether	Enflurane
2-Chloro-1-ethanal	Chloroacetaldehyde
2-Ethylhexyl chlorocarbonate	2-Ethylhexyl chloroformate
2-Furacarboxyaldehde	2-furaldehyde (furfural)
2-Furanaldehyde	2-furaldehyde (furfural)
2-Furancarbonal	2-furaldehyde (furfural)
2-Hexanone	Hexan-2-one
2-Hydroxypropyl acrylate	2-Hydroxypropyl acrylate
2-Isopropoxyphenyl methylcarbamate	Propoxur (ISO)
2-Methoxy-1-methylethylacetate	1-Methoxypropyl acetate
2-Methoxy-2-methylpropane	Methyl-tert-butyl ether
2-Methyl-1-propyl acetate	Isobutyl acetate
2-Methyl-2-propenenitrile	Methacrylonitrile
2-Methyl-2-propenoic acid	Methyl methacrylate
2-Methylaniline	o-Toluidine
2-NP	2-Nitropropane
2-Oxohexamethylenimine	1,6-Hexanolactam (e-caprolactam)
2-Pentyl acetate	Pentyl acetates (all isomers)
2-Phenylpropane	Cumene
2-Propanol	Propan-2-ol
2-Propen-1-ol	Allyl alcohol
2-Propenamide	Acrylamide
2-Propenenitrile	Acrylonitrile
2-Propenoic acid 2-cyano ethyl ester	Ethyl cyanoacrylate
2-Propenoic acid 2-cyano methyl ester	Methyl cyanoacrylate
2-Propenoic acid, n-butyl ester	n-Butyl acrylate
2-Propenoic ethyl ester	Ethyl acrylate
2-Toluidine	o-Toluidine
3-(3,4-Dichlorophenyl)-1,1-dimethylurea	Diuron (ISO)
3,3’-Dichloro-4,4’-diaminodiphenyl methane	2,2’-Dichloro-4, 4’-methylene dianiline (MbOCA)
3a,4,7,7a-Tetrahydro-4,7-methanoindene	Dicyclopentadiene
3-Heptanone	Heptan-3-one
3-Hydroxypropene	Allyl alcohol
3-pentyl acetate	Pentyl acetates (all isomers)
4,4’-Diaminodiphenylmethane	4,4’-Methylenedianiline
4,4’-Diamino-3,3’-dichlorodiphenylmethane	2,2’-Dichloro-4, 4’-methylene dianiline (MbOCA)
4,4-Methylene bis(2-chloroaniline)	2,2’-Dichloro-4, 4’-methylene dianiline (MbOCA)

Substance	*Name it is listed by in Table 1*
4,4’-Thiobis(6-tert-butyl-m-cresol)	6,6’-Di-tert-butyl-4,4’-thiodi-m-cresol
4-Acetamidophenol	Paracetamol
4-Amino-3,5,6-trichloropyridine-2-carboxylic acid	Picloram (ISO)
4-Hydroxyacetanilide	Paracetamol
5-Bromo-3-sec-butyl-6-methyluracil	Bromacil (ISO)
Acetaminophen	Paracetamol
Acetanhydride	Acetic anhydride
Acetic acid amyl ester	Pentyl acetates (all isomers)
Acetic acid anhydride	Acetic anhydride
Acetic acid dimethylamide	NN-Dimethylacetamide
Acetic acid, 1,1-dimethylethyl ester	tert-Butyl acetate
Acetic aldehyde	Acetaldehyde
Acetic oxide	Acetic anhydride
Acetyl ether	Acetic anhydride
Acetyl oxide	Acetic anhydride
Acetylene dichloride	1,2-Dichloroethylene, cistrans isomers 60:40
Acetylene tetrabromide	1,1,2,2-Tetrabromoethane
Acrolein	Acrylaldehyde (Acrolein)
Acrylic acid 2-cyano ethyl ester	Ethyl cyanoacrylate
Acrylic acid 2-cyano methyl ester	Methyl cyanoacrylate
Acrylic acid, n-butyl ester	n-Butyl acrylate
ACT	Benzyl chloride
alpha-Chlorotoluene	Benzyl chloride
alpha-Methyl styrene	2-Phenylpropene
Alumina	Aluminium oxides
Aluminium alkyl compounds	Aluminium alkyl compounds
Aluminium metal	Aluminium metal
Aluminium salts, soluble	Aluminium salts, soluble
Alumite	Aluminium oxides
Aminobenzene	Aniline
Aminocaprolactam	1,6-Hexanolactam (e-caprolactam)
Aminocyclohexane	Cyclohexylamine
Aminoethane	Ethylamine
Ammonia, anhydrous	Ammonia, anhydrous
Ammonium chloride, fume	Ammonium chloride, fume
Ammonium hexachloroplantinate	Halogeno-platinum compounds (as Pt)
Ammonium sulphamate	Ammonium sulphamidate
Ammonium tetrachloroplantinate	Halogeno-platinum compounds (as Pt)
Amyl acetates (all isomers)	Pentyl acetates (all isomers)
Amyl ethyl ketone	5-Methylheptan-3-one
Amylmethylketone	Heptan-2-one
Antimony and compounds except stibine (as Sb)	Antimony and compounds except stibine (as Sb)
Araldite PT-810	Triglycidyl isocyanurate (TGIC)
Arcton 22	Chlorodifluoromethane
Aroclor	Polychlorinated biphenyls (PCB)
Arsenic and arsenic compounds except arsine (as As)	Arsenic and arsenic compounds except arsine (as As)
Arsenic trihydride	Arsine
Arylamine	Aniline
Asphalt, petroleum fumes	Asphalt, petroleum fumes
Aspirin	o-Acetylsalicylic acid
Azabenzene	Pyridine
Azacyclohexane	Piperidine
Barite	Barium sulphate
Barium Compounds	Barium Compounds

Substance	*Name it is listed by in Table 1*
Barytes	Barium sulphate
BCME	Bis(chloromethyl ether)
Benzenamine	Aniline
Benzene chloride	Chlorobenzene
Benzol	Benzene
Benzoyl peroxide	Dibenzoyl peroxide
Beryllium and beryllium compounds (as Be)	Beryllium and beryllium compounds (as Be)
Beta-propanolol	Propranolol
Bicyclo(2,2,1)heptan-2-one	Bornan-2-one
Bismuth telluride	Dibismuth tritelluride
Bladafum	Sulfotep (ISO)
Blanc fixe	Barium sulphate
Borates, (tetra) sodium salts	Disodium tetraborate, anhydrous
Borates, (tetra) sodium salts	Disodium tetraborate, decahydrate
Borates, (tetra) sodium salts	Disodium tetraborate, pentahydrate
Boron oxide	Diboron trioxide
Boron tribromide	Boron tribromide
Bromine	Bromine
Butane	Butane
Butanone	Butan-2-one (methyl ethyl ketone)
Butyl acrylate	n-Butyl acrylate
Butyl benzyl phthalate	Benzyl butyl phthalate
Butyl cellosolve	2-Butoxyethanol
Butyl cellosolve acetate	2-Butoxyethyl acetate
Butyl ethyl ketone	Heptan-3-one
Butyl glycol	2-Butoxyethanol
Butyl glycol acetate	2-Butoxyethyl acetate
Butyl methyl ketone	Hexan-2-one
Butyl oxitol	2-Butoxyethanol
Butyl phosphate	Tributyl phosphate, all isomers
Butylated hydroxytoluene	2,6-Di-tert-butyl-p-cresol
Butylene oxide	Tetrahydrofuran
Butylglycol acetate	2-Butoxyethyl acetate
C,C’-azodi(formamide)	Azodicarbonamide
Cadmium & cadmium compounds except cadmium oxide fume, cadmium sulphide & cadmium sulphide pigments	Cadmium & cadmium compounds except cadmium oxide fume, cadmium sulphide & cadmium sulphide pigments
Cadmium oxide fume (as Cd)	Cadmium oxide fume (as Cd)
Cadmium sulphide and cadmium sulphide pigments pigments (respirable dust (as Cd))	Cadmium sulphide and cadmium sulphide (respirable dust (as Cd))
Caesium hydroxide	Caesium hydroxide
Calcite	Marble
Calcium carbonate	Calcium carbonate
Calcium cyanamide	Calcium cyanamide
Calcium hydroxide	Calcium hydroxide
Calcium oxide	Calcium oxide
Calcium silicate	Calcium silicate
Calcium sulphate	Gypsum
Calcium sulphate	Plaster of Paris
Camphor, synthetic	Bornan-2-one
Caprolactam	1,6-Hexanolactam (e-caprolactam)
Carbamaldehyde	Formamide
Carbimides	Isocyanates
Carbodiimide	Cyanamide

Substance	*Name it is listed by in Table 1*
Carbon bisulphide	Carbon disulphide
Carbon black	Carbon black
Carbon oxychloride	Phosgene
Carbonic anhydride	Carbon Dioxide
Carbonic oxide	Carbon monoxide
Carbonimides	Isocyanates
Carbonyl chloride	Phosgene
Carbylamines	Isocyanates
Catechol	Pyrocatechol
Cellosolve	2-Ethoxyethanol
Cellosolve acetate	2-Ethoxyethyl acetate
Cellulose	Cellulose (pure)
Cement dust	Portland cement
CFC-114	Cryofluorane (INN)
Chlorinated biphenyls	Polychlorinated biphenyls (PCB)
Chlorine	Chlorine
Chlorine (IV) oxide	Chlorine dioxide
Chlorine oxide	Chlorine dioxide
Chlorine peroxide	Chlorine dioxide
Chloroacetic acid	Monochloroacetic acid
Chlorobenzol	Chlorobenzene
Chlorocyanogen	Cyanogen chloride
Chloroethylene	Vinyl chloride
Chloromethyl ether	Bis (chloromethyl ether)
Chloromethyloxirane	1-Chloro-2, 3-epoxypropane (Epichlorohydrin)
Chlorophenylmethane	Benzyl chloride
Chlorosulphonic acid	Chlorosulphonic acid
Chromium	Chromium
Chromium (II) compounds	Chromium (II) compounds
Chromium (III) compounds	Chromium (III) compounds
Chromium (VI) compounds (as Cr)	Chromium (VI) compounds (as Cr)
Cinerin	Pyrethrins (ISO)
cis-Butenedioic anhydride	Maleic anhydride
Cobalt and cobalt compounds (as Co)	Cobalt and cobalt compounds (as Co)
Colophony	Rosin-based solder flux fume
Copper	Copper
Cotton dust	Cotton dust
Cristobalite, respirable dust	Silica, respirable crystalline
Crystalline silica, respirable dust	Silica, respirable crystalline
Cyanides, except HCN, cyanogen & cyanogen chloride chloride	Cyanides, except HCN, cyanogen & cyanogen
Cyanoethylene	Acrylonitrile
Cyanolit	Methyl cyanoacrylate
Cyanomethane	Acetonitrile
Cyclohexane	Cyclohexane
Cyclohexanone isooxime	1,6-Hexanolactam (e-caprolactam)
Dactin	1,3-Dichloro-5,5-dimethyl-hydantoin
DADPM	4,4’-Methylenedianiline
DDM	4,4’-Methylenedianiline
DEHP	Bis(2-ethylhexyl) phthalate
Derris, commercial	Rotenone (ISO)
Diacetone alcohol	4-Hydroxy-4-methylpentan-2-one
Dialkyl 79 phthalate	Dialkyl 79 phthalate
Diamine	Hydrazine
Diatomaceous earth, natural, respirable dust	Diatomaceous earth, natural, respirable dust

Substance	*Name it is listed by in Table 1*
Diazenedicarboxamide	Azodicarbonamide
Dibutyl phthalate	Dibutyl phthalate
Dichloroacetylene	Dichloroacetylene
Dicyclohexyl phthalate	Dicyclohexyl phthalate
Diethyl ketone	Pentan-3-one
Diethyl oxide	Diethyl ether
Diethyl phthalate	Diethyl phthalate
Diethylene glycol	2,2’-Oxydiethanol
Diethylene imidoximine	Morpholine
Diethylene oxide	Tetrahydrofuran
Diethylene oximine	Morpholine
Diethylene triamine	2,2’-Iminodi (ethylamine)
Diethylenediamine	Piperazine
Diethylenediamine dihydrochloride	Piperazine dihydrochloride
Diethyleneimine	Piperazine
Difluorochloromethane	Chlorodifluoromethane
Diisobutyl ketone	2,6-Dimethylheptan-4-one
Diisobutyl phthalate	Diisobutyl phthalate
Diisodecyl phthalate	Diisodecyl phthalate
Diisononyl phthalate	Diisononyl phthalate
Diisooctyl phthalate	Diisooctyl phthalate
Diisopropylamine	Diisopropylamine
Dimethyl ketone	Acetone
Dimethyl phthalate	Dimethyl phthalate
Dimethyl sulphate	Dimethyl sulphate
Dimethylbenzene	Xylene, o-,m-,-p- or mixed isomers
Dimethylethanolamine	Dimethylaminoethanol
Dimethylethylamine	N,N-Dimethylethylamine
Dimethylnitromethane	2-Nitropropane
Di-n-butyl phosphate	Dibutyl hydrogen phosphate
Dinitrobenzene, all isomers	Dinitrobenzene, all isomers
Dinitrogen monoxide	Nitrous oxide
Dioxan	1,4-Dioxane
Diphenylamine	Diphenylamine
Dipropylene glycol methyl ether	(2-methoxymethylethoxy) propanol
Dipropylene glycol monomethyl ether	(2-methoxymethylethoxy) propanol
Dipropylmethane	n-Heptane
Dipyrido[1,2-a:2’,1’-c]pyrazinediium, 6,7-dihydro-, dibromide	Diquat dibromide (ISO)
Di-sec-octyl phthalate	Bis(2-ethylhexyl) phthalate
Dithiocarbonic anhydride	Carbon disulphide
Dithiofos	Sulfotep (ISO)
Dithiophosphoric acid, tetraethyl ester	Sulfotep (ISO)
Dithiotep	Sulfotep (ISO)
Divanadium pentoxide	Vanadium pentoxide
DMA	NN-Dimethylacetamide
DMAc	NN-Dimethylacetamide
DMAE	Dimethylaminoethanol
DME	Dimethyl ether
DMEA	Dimethylaminoethanol
DMF	Dimethylformamide
DMS	Dimethyl sulphate
DPGME	(2-methoxymethylethoxy) propanol
Dursban	Chlorpyrifos (ISO)
EAK	5-Methylheptan-3-one
EBK	Heptan-3-one
ECA	Ethyl cyanoacrylate

Substance	Name it is listed by in Table 1
e-Caprolactam	1,6-Hexanolactam (e-caprolactam)
ECH	1-Chloro-2, 3-epoxypropane (Epichlorohydrin)
EDB	1,2-Dibromoethane (Ethylene dibromide)
Emery	Emery
Enthrane	Enflurane
Epichlorohydrin	1-Chloro-2, 3-epoxypropane (Epichlorohydrin)
Epoxyethane	Ethylene oxide
Ethanal	Acetaldehyde
Ethanamine	Ethylamine
Ethanedioic acid	Oxalic acid
Ethanediol	Ethane-1,2-diol
Ethanoic anhydride	Acetic anhydride
Ethanolamine	2-Aminoethanol
Ether	Diethyl ether
Ether hydrochloric	Chlorethane
Ethrane	Enflurane
Ethyl 2-propenoate	Ethyl acrylate
Ethyl acetate	Ethyl acetate
Ethyl acetate ester	Ethyl acetate
Ethyl alcohol	Ethanol
Ethyl aldehyde	Acetaldehyde
Ethyl amyl ketone	5-Methylheptan-3-one
Ethyl butyl ketone	Heptan-3-one
Ethyl chloride	Chloroethane
Ethyl chlorocarbonate	Ethyl chloroformate
Ethyl ethanoate	Ethyl acetate
Ethyl ether	Diethyl ether
Ethyl mercaptan	Ethanethiol
Ethyl methanoate	Ethyl formate
Ethyl oxide	Diethyl ether
Ethyl thiopyrophosphate	Sulfotep (ISO)
Ethyl-2-cyano-2-propenoate	Ethyl cyanoacrylate
Ethyl-2-cyanoacrylate	Ethyl cyanoacrylate
Ethylene chlorohydrin	2-Chloroethanol
Ethylene dibromide	1,2-Dibromoethane (Ethylene dibromide)
Ethylene dichloride	1,2-Dichloroethane (Ethylene dichloride)
Ethylene glycol	Ethane-1,2-diol
Ethylene glycol dimethyl ether	Dimethoxymethane
Ethylene glycol monobutyl ether	2-Butoxyethanol
Ethylene glycol monobutyl ether acetate	2-Butoxyethyl acetate
Ethylene glycol monoethyl ether	2-Ethoxyethanol
Ethylene glycol monoethyl ether acetate	2-Ethoxyethyl acetate
Ethylene glycol monomethyl ether	2-Methoxyethanol
Ethylene glycol monomethyl ether acetate	2-Methoxyethyl acetate
Ethylene tetrachloride	Tetrachloroethylene
Ethylidene chloride	1,1-Dichloroethane
Ethylidene dichloride	1,1-Dichloroethane
Ferric oxide	Rouge
Ferrous foundry particulate	Ferrous foundry particulate
Flour dust	Flour Dust
Flue gas	Carbon monoxide
Fluoride (inorganic as F)	Fluoride (inorganic as F)
Fluorine	Fluorine
Fluothane	Halothane
Forane	Isoflurane

Substance	*Name it is listed by in Table 1*
Formic aldehyde	Formaldehyde
Freon 123B1	Halothane
Freon 134a	1,1,1,2-Tetrafluoroethane (HFC 134a)
Freon 22	Chlorodifluoromethane
Fural	2-furaldehyde (furfural)
Furfural	2-furaldehyde (furfural)
Furfuraldehyde	2-furaldehyde (furfural)
Germanium tetrahydride	Germane
Glutaral	Glutaraldehyde
Glutardialdehyde	Glutaraldehyde
Glutaric dialdehyde	Glutaraldehyde
Glycerin, mist	Glycerol, mist
Glycol	Ethane-1,2-diol
Grain dust	Grain dust
Graphite	Graphite
Halane	1,3-Dichloro-5,5-dimethyl-hydantoin
Halogeno-platinum compounds (complex co-ordination compounds in which the platinum atom is directly co-ordinated to halide groups) (as Pt)	Halogeno-platinum compounds (complex co-ordination compounds in which the platinum atom is directly co-ordinated to halide groups) (as Pt)
Hardwood dust	Hardwood dust
HCFC 22	Chlorodifluoromethane
HCFC-21	Dichlorofluoromethane
Heavy spar	Barium sulphate
Hexahydro-1,4-diazine	Piperazine
Hexahydro-2H-azepin-2-one	1,6-Hexanolactam (e-caprolactam)
Hexahydrobenzene	Cyclohexane
Hexahydropyrazine	Piperazine
Hexalin	Cyclohexanol
Hexamethylene	Cyclohexane
Hexane	n-Hexane
Hexanon	Cyclohexanone
Hexylene glycol	2-Methylpentane-2,4-diol
HFC 134a	1,1,1,2-Tetrafluoroethane
Hydrobromic acid	Hydrogen bromide
Hydrobromic gas	Hydrogen bromide
Hydrochloric acid	Hydrogen chloride (gas and aerosol mists)
Hydrocyanic acid	Hydrogen cyanide
Hydrofluoric acid	Hydrogen fluoride (as F)
Hydrofuran	Tetrahydrofuran
Hydrogen peroxide	Hydrogen peroxide
Hydrogen phosphide	Phosphine
Hydrogen selenide	Dihydrogen selenide (as Se)
Hydrosulphuric acid	Hydrogen sulphide
Hydrous magnesium silicate	Talc
Hydroxybenzene	Phenol
Indium and compounds (as In)	Indium and compounds (as In)
Indonaphthene	Indene
Iodine	Iodine
Iron oxide, fume (as Fe)	Iron oxide, fume (as Fe)
Iron pentacarbonyl (as Fe)	Pentacarbonyliron (as Fe)
Iron salts (as Fe)	Iron salts (as Fe)
Isoamyl alcohol	3-Methylbutan-1-ol
Isoamyl methyl ketone	5-Methylhexan-2-one

Substance	*Name it is listed by in Table 1*
Isobutyl alcohol	2-Methylpropan-1-ol
Isocyanates, all (as –NCO)	Isocyanates, all (as –NCO)
Isocyanic acid esters	Isocyanates
Isonitropropane	2-Nitropropane
Isooctanol	Isooctyl alcohol (mixed isomers)
Isopentyl acetate	Pentyl acetates (all isomers)
Isopentyl methyl ketone	5-Methylhexan-2-one
Isophorone	3,5,5-trimethylcyclohex-2-enone
Isopropanol	Propan-2-ol
Isopropyl acetone	4-Methylpentan-2-one
Isopropyl alcohol	Propan-2-ol
Isopropyl chlorocarbonate	Isopropyl chloroformate
Isopropyl ether	Diisopropyl ether
Isopropylbenzene	Cumene
Jasmolin	Pyrethrins (ISO)
Kaolin, respirable dust	Kaolin, respirable dust
Ketohexamethylene	Cyclohexanone
Laughing gas	Nitrous oxide
Limestone	Limestone
Lithium hydride	Lithium hydride
Lithium hydroxide	Lithium hydroxide
LPG	Liquefied petroleum gas
Magnesia	Magnesium oxide (as Mg)
Magnesium carbonate	Magnesite
Maleic acid anhydride	Maleic anhydride
Manganese and its inorganic compounds	Manganese and its inorganic compounds
MbOCA	2,2’-Dichloro-4,4’-methylene dianiline (MbOCA)
MCA	Methyl cyanoacrylate
MDA	4,4’-Methylenedianiline
m-Dihydroxybenzene	Resorcinol
Mecrylate	Methyl cyanoacrylate
MEK	Butan-2-one (methyl ethyl ketone)
MEKP	Methyl ethyl ketone peroxides (MEKP)
Methacide	Toluene
Methacrylic acid methyl ester	Methyl methacrylate
Methanal	Formaldehyde
Methanamide	Formamide
Methane trichloride	Chloroform
Methanoic acid	Formic Acid
Methyl 2-methyl-2-propenoate	Methyl methacrylate
Methyl acetate	Methyl acetate
Methyl alcohol	Methanol
Methyl aldehyde	Formaldehyde
Methyl bromide	Bromomethane
Methyl butyl ketone	Hexan-2-one
Methyl cellosolve	2-Methoxyethanol
Methyl cellosolve acetate	2-Methoxyethyl acetate
Methyl chloride	Chloromethane
Methyl chloroform	1,1,1-Trichloroethane
Methyl ester	Methyl methacrylate
Methyl ether	Dimethyl ether
Methyl ethyl ketone	Butan-2-one (methyl ethyl ketone)
Methyl ethylene oxide	Propylene oxide
Methyl iodide	Iodomethane

Substance	*Name it is listed by in Table 1*
Methyl isoamyl ketone	5-Methylhexan-2-one
Methyl isobutyl carbinol	4-Methylpentan-2-ol
Methyl isobutyl ketone	4-Methylpentan-2-one
Methyl ketone	Acetone
Methyl mercaptan	Methanethiol
Methyl n-butyl ketone	Hexan-2-one
Methyl phosphite	Trimethyl phosphite
Methyl propyl ketone	Pentan-2-one
Methyl-1,1-dimethyethyl ether	Methyl-tert-butyl ether
Methyl-2-cyano-2-propenoate	Methyl cyanoacrylate
Methyl-2-cyanoacrylate	Methyl cyanoacrylate
Methylacetic acid	Propionic acid
Methylacetone	Butan-2-one (methyl ethyl ketone)
Methylal	Dimethoxymethane
Methylamylketone	Heptan-2-one
Methylaniline	N-Methylaniline
Methylbenzene	Toluene
Methylbutyl acetate	Pentyl acetates (all isomers)
Methyldichloromethane	1,1-Dichloroethane
Methylene chloride	Dichloromethane
Methylene oxide	Formaldehyde
Methylene-bis-orthochloroaniline MbOCA	2,2’-Dichloro-4, 4’-methylene dianiline (MbOCA)
Methylhexalin	Methylcyclohexanol
Methyloxirane	Propylene oxide
MIAK	5-Methylhexan-2-one
MIBK	4-Methylpentan-2-one
MMMFs	MMMF (Machine-made mineral fibre) (except for Refractory Ceramic Fibres and Special Purpose Fibres)
Molybdenum compounds (as Mo)	Molybdenum compounds (as Mo)
Monochlorobenzene	Chlorobenzene
Monochlorodifluoromethane	Chlorodifluoromethane
Monoethylamine	Ethylamine
M-Pyrol	1-Methyl-2-pyrrolidone
MTBE	Methyl-tert-butyl ether
Muriatic acid	Hydrogen chloride (gas and aerosol mists)
N-(4-Hydroxyphenyl)acetamide	Paracetamol
N,N-diethylethanamine	Triethylamine
N,N-Diethylethanolamine	2-Dimethylaminoethanol
N,N-Dimethylethanolamnie	Dimethylaminoethanol
N,N-Dimethylformamide	Dimethylformamide
Nadone	Cyclohexanone
n-Butanol	Butan-1-ol
n-Butyl acetate	Butyl acetate
n-Butyl alcohol	Butan-1-ol
n-Butyl chlorocarbonate	n-Butyl chloroformate
n-Butyl lactate	Butyl lactate
N-Diethylaminoethanol	2-Dimethylaminoethanol
N-Ethylethanamine	Diethylamine
N-Ethylmorpholine	4-Ethylmorpholine
Nickel and its inorganic compounds (except nickel carbonyl)	Nickel and its inorganic compounds (except nickel carbonyl)
Nickel and its inorganic compounds (except nickel tetracarbonyl): water-soluble nickel compounds (as Ni)	Nickel and its inorganic compounds (except nickel tetracarbonyl): water-soluble nickel compounds (as Ni)

Substance	*Name it is listed by in Table 1*
nickel and water-insoluble nickel compounds (as Ni)	nickel and water-insoluble nickel compounds (as Ni)
Nickel carbonyl	Tetracarbonylnickel
Nitric Acid	Nitric Acid
Nitrobenzol	Nitrobenzene
Nitroisopropane	2-Nitropropane
Nitromethane	Nitromethane
N-methyl-2-pyrrolidinone	1-Methyl-2-pyrrolidone
N-Methylmethanamine	Dimethylamine
N-methylpyrrolidone	1-Methyl-2-pyrrolidone
n-Propanol	Propan-1-ol
N-Trichloromethylmercapto-4-cyclohexene-1,2-dicarboximide	Captan (ISO)
O,O,O’,O’-Tetraethyldithio-pyrophosphate	Sulfotep (ISO)
O,O-Diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate	Chlorpyrifos (ISO)
O,O-Diethyl S-ethylthiomethyl phosphorodithioate	Phorate (ISO)
o-Dichlorobenzene	1,2-Dichlorobenzene (ortho-dichlorobenzene)
omega-Chlorotoluene	Benzyl chloride
o-Methylcyclohexanone	2-Methylcyclohexanone
Orsin	p-Phenylenediamine
ortho-Dichlorobenzene	1,2-Dichlorobenzene
o-sec-Butylphenol	2-sec-Butylphenol
Osmium tetraoxide (as Os)	Osmium tetraoxide (as Os)
Oxirane	Ethylene oxide
Oxomethane	Formaldehyde
Oxybis(chloromethane)	Bis (chloromethyl ether)
Oxybismethane	Dimethyl ether
Oxymethylene	Formaldehyde
p-Aminoaniline	p-Phenylenediamine
para-Dichlorobenzene	1,4-Dichlorobenzene
Paraffin wax, fume	Paraffin wax, fume
PCBs	Polychlorinated biphenyls (PCB)
p-Chloronitrobenzene	1-Chloro-4-nitrobenzene
p-Dichlorobenzene	1,4-Dichlorobenzene (para-dichlorobenzene)
Pentan-1,5-dial	Glutaraldehyde
Perc	Tetrachloroethylene
Perchloroethylene	Tetrachloroethylene
Periclase	Magnesium oxide (as Mg)
PGME	1-Methoxypropan-2-ol
PGMEA	1-Methoxypropyl acetate
Phenacyl chloride	2-Chloroacetophenone
Phenyl chloride	Chlorobenzene
Phenyl ether	Diphenyl ether (vapour)
Phenylamine	Aniline
Phenylethane	Ethylbenzene
Phenylethylene	Styrene
Phenylmethane	Toluene
Phosphoric acid	Orthophosphoric acid
Phosphoric chloride	Phosphorus pentachloride
Phosphorous chloride	Phosphorus trichloride
Phosphorus (V) oxide	Diphosporus pentoxide
Phosphorus pentasulphide	Diphosphorus pentasulphide
Phosphorus pentoxide	Diphosphorus pentoxide
Phosphorus perchloride	Phosphorus pentachloride
Phosphorus trihydride	Phosphine

Substance	*Name it is listed by in Table 1*
Phosphorus, yellow	Phosphorus, yellow
Phosphoryl trichloride	Phosphoryl trichloride
Phosporus pentoxide	Diphosporus pentoxide
Phthalic acid anhydride	Phthalic anhydride
Pimelic ketone	Cyclohexanone
Piperazidine	Piperazine
Piperazine hydrochloride	Piperazine dihydrochloride
Platinum compds, soluble (except certain halogeno-Pt compounds) (as Pt)	Platinum compds, soluble (except certain halogeno-Pt compounds) (as Pt)
Platinum metal	Platinum metal
p-Nitrochlorobenzene	1-Chloro-4-nitrobenzene
Polychlorobiphenyls	Polychlorinated biphenyls (PCB)
Polymeric aromatic amide derivative	p-Aramid respirable fibres
Potassium hydroxide	Potassium hydroxide
p-Phenylene terephthalamide	p-Aramid respirable fibres
Precipitator ash	Pulverised fuel ash
Propan-2-one	Acetone
Propanoic acid	Propionic acid
Propanone	Acetone
Propene oxide	Propylene oxide
Propenol	Allyl alcohol
Propenol alcohol	Allyl alcohol
Propionic acid	Propionic acid
Propylene glycol	Propane-1,2-diol
Propylene glycol methyl ether	1-Methoxypropan-2-ol
Propylene glycol methyl ether acetate	1-Methoxypropyl acetate
Propylene glycol-1-monomethyl ether	1-Methoxypropan-2-ol
Propylene glycol-1-monomethylether-2-acetate	1-Methoxypropyl acetate
Prussic acid	Hydrogen cyanide
PVC	Polyvinyl chloride
Pyrazine hexahydride	Piperazine
Pyrethrin	Pyrethrins (ISO)
Pyrethrins (Pyrethrum)	Pyrethrins (Pyrethrum)
Pyridinecarboxylic acid	Picloram (ISO)
Pyromucic aldehyde	2-furaldehyde (furfural)
Quartz, crystyalline	Silica, respirable crystalline
Quinol	Hydroquinone
RCF	Refractory Ceramic Fibres and Special Purpose
Fibres	
Resorcin	Resorcinol
Respirable Crystalline Silica (RCS)	Respirable Crystalline Silica (RCS)
Rhodium (as Rh)	Rhodium (as Rh)
Rubber fume	Rubber fume
Rubber process dust	Rubber process dust
sec-Butanol	Butan-2-ol
sec-Butyl acetate	sec-Butyl acetate
sec-Butyl alcohol	Butan-2-ol
Selane	Dihydrogen selenide (as Se)
Selenium and compounds, except hydrogen selenide (as Se) selenide	Selenium and compounds, except hydrogen (as Se)
Selenium dihydride	Dihydrogen selenide (as Se)
Selenium hydride	Dihydrogen selenide (as Se)
Sextone	Cyclohexanone
Silane	Silane
Silica, amorphous	Silica, amorphous
Silica, fused respirable dust	Silica, fused respirable dust

Substance	Name it is listed by in Table 1
Silicon	Silicon
Silicon carbide (not whiskers)	Silicon carbide (not whiskers)
Silver (soluble compounds as Ag)	Silver (soluble compounds as Ag)
Silver compounds	Silver compounds
Silver, metallic	Silver, metallic
Soapstone	Mica
Sodium azide (as NaN_3)	Sodium azide (as NaN_3)
Sodium bisulphite	Sodium hydrogen sulphite
Sodium hydroxide	Sodium hydroxide
Sodium metabisuphite	Disodium disulphite
Sodium pyrophosphate	Tetrasodium pyrophosphate
Softwood dust	Softwood dust
Starch	Starch
Styrol	Styrene
Subtilisins	Subtilisins
Sulphur hexafluoride	Sulphur hexafluoride
Sulphur monochloride	Disulphur dichloride
Sulphur oxychloride	Thionyl chloride
Sulphuretted hydrogen	Hydrogen sulphide
Sulphuric acid diethyl ester	Diethyl sulphate
Sulphuric acid, dimethyl ester	Dimethyl sulphate
Sulphuryl fluoride	Sulphuryl difluoride
Suphuric oxyfluoride	Sulphuryl difluoride
sym-Dichlorodimethyl ether	Bis (chloromethyl ether)
sym-Dichloroethane	1,2-Dichloroethane (Ethylene dichloride)
sym-Dichoroethylene	1,2-Dichloroethylene, cistrans isomers 60:40
Talc, respirable dust	Talc, respirable dust
Talcum	Talc
Tantalum	Tantalum
TEDP	Sulfotep (ISO)
Tellurium & compounds, except hydrogen telluride, (as Te)	Tellurium & compounds, except hydrogen telluride, (as Te)
Terphenyls, all isomers	Terphenyls, all isomers
tert-amyl acetate)	Pentyl acetates (all isomers)
tert-Butyl alcohol	2-Methylpropan-2-ol
tert-Butyl methyl ether	Methyl-tert-butyl ether
Tetrachloroethene	Tetrachloroethylene
Tetrachloromethane	Carbon tetrachloride
Tetrahydro-1,4-oxazine	Morpholine
TGIC	Triglycidyl isocyanurate (TGIC)
Thallium, soluble compounds (as Tl)	Thallium, soluble compounds (as Tl)
Thioglycolic acid	Mercaptoacetic acid
Thiosulfan	Endosulfan (ISO)
Tin compounds, inorganic, except SnH_4, (as Sn)	Tin compounds, inorganic, except SnH_4, (as Sn)
Tin compounds, organic, except Cyhexatin (ISO), (as Sn)	Tin compounds, organic, except Cyhexatin (ISO), (as Sn)
Titanium dioxide	Titanium dioxide
TMA	Trimellitic anhydride
TNT	2,4,6-Trinitrotoluene
Toluol	Toluene
Tolyl chloride	Benzyl chloride
Tosyl chloride	p-Toluenesulphonyl chloride
Toxilic anhydride	Maleic anhydride
Triatomic oxygen	Ozone
Trichloroethene	Trichloroethylene
Trichloromethane	Chloroform

Substance	Name it is listed by in Table 1
Triiodomethane	Iodoform
Trike	Trichloroethylene
Trilene	Trichloroethylene
Trimethylbenzenes, all isomers or mixtures	Trimethylbenzenes, all isomers or mixtures
Tri-o-cresyl phosphate	Tri-o-tolyl phosphate
Triphenyl phosphate	Triphenyl phosphate
Tripoli, respirable dust	Silica, respirable crystalline
Trydimite, respirable dust	Silica, respirable crystalline
Tungsten & compounds (as W)	Tungsten & compounds (as W)
Turpentine	Turpentine
VCM	Vinyl chloride
Vinyl carbinol	Allyl alcohol
Vinyl chloride monomer	Vinyl chloride
Vinyl cyanide	Acrylonitrile
Vinylbenzene	Styrene
water-soluble nickel compounds	water-soluble nickel compounds
nickel and water-insoluble nickel compounds	nickel and water-insoluble nickel compounds
Wool process dust	Wool process dust
Xylol	Xylene, o-,m-,-p- or mixed isomers
Yttrium	Yttrium
Zinc chloride, fume	Zinc chloride, fume
Zinc distearate	Zinc distearate
Zirconium compounds (as Zr)	Zirconium compounds (as Zr)
α-Chlorotoluene	Benzyl chloride

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