

LIST OF WORKPLACE EXPOSURE LIMITS (WELS) AND OTHER TABLES

Annotations

BMGV Biological Monitoring Guidance Value is listed in table

Carc Capable of causing cancer. 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*; or
- a substance or process listed in Schedule 1 of COSHH.

Sen Capable of causing respiratory sensitisation. 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 which are listed in section C of HSE publication 'Asthma? Critical assessments of the evidence for agents implicated in occupational asthma'⁽¹⁾ 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 total 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 total inhalable dust*, 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.

⁽¹⁾ HSE Books 1997 ISBN 0 7176 1465 4

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 (n =396)

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		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					
total inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Aluminium oxides	1344-28-1					
total inhalable dust		-	10	-	-	
respirable dust		-	4	-	-	
Aluminium salts, soluble		-	2	-	-	
2-Aminoethanol	141-43-5	3	7.6	6	15	R20/21/22, 34*
Ammonia, anhydrous	7664-41-7	25	18	35	25	R10, 23, 34, 50*

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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	-	-	
<i>p</i> -Aramid respirable fibres	26125-61-1	0.5 fibres/ml		-	-	
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 total inhalable dust respirable dust	7727-43-7	- -	10 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

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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	0.3	2	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
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
<i>n</i> -Butyl acrylate	141-32-2	1	5	5	26	R10, 36/37/38, 43
<i>n</i> -Butyl chloroformate	592-34-7	1	5.7	-	-	R10, 23, 34

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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 compounds 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 total inhalable dust respirable	1317-65-3	- -	10 4	- -	- -	
Calcium cyanamide	156-62-7	-	0.5	-	1	R22, 37, 41
Calcium hydroxide	1305-62-0	-	5	-	-	
Calcium oxide	1305-78-8	-	2	-	-	
Calcium silicate total inhalable dust respirable	1344-95-2	- -	10 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	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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 (pure) total inhalable dust respirable	9004-34-6	- -	10 4	- -	20 -	
Chlorine	7782-50-5	0.5	1.5	1	2.9	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
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

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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*
Cobalt and cobalt compounds (as Co)		-	0.1	-	-	Carc (cobalt dichloride and sulphate) Sen (cobalt metal)
Copper fume dusts and mists (as Cu)	7440-50-8	- -	0.2 1	- -	- 2	
Cotton dust	See page xx	-	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	-	2	-	-	R21, 25, 36/38, 43
Cyanides, except HCN, cyanogen & 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

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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	-	-	
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, cistrans isomers 60:40	540-59-0	200	806	250	1010	R11, 20, 52/53*
Dichlorofluoromethane	75-43-4	10	43	-	-	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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	10	30	25	76	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	
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
<i>N,N</i> -Dimethylacetamide	127-19-5	10	36	20	72	Sk BMGV R20/21, 61

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
<i>N,N</i> -Dimethylaniline	121-69-7	5	25	10	50	Sk R23/24/25, 40, 51/53
<i>N,N</i> -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, tech. grade	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	-	3	R11, 20/22, 29, 50
Diphosphorus pentoxide	1314-56-3	-	-	-	2	R35
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	-	-	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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 total inhalable dust respirable	1302-74-5	- -	10 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 particulate vapour	107-21-1	- 20	10 52	- 40	- 104	Sk R22
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

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Ethylbenzene	100-41-4	100	441	125	552	Sk R11, 20
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 total inhalable dust respirable dust	See page xx	- -	10 4	- -	- -	
Flour Dust	See page xx	-	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

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Glycerol, mist	56-81-5	-	10	-	-	
Grain dust	See page xx	-	10	-	-	Sen
Graphite total inhalable dust respirable	7440-44-0	- -	10 4	- -	- -	
Gypsum total inhalable dust respirable	10101-41-4	- -	10 4	- -	- -	
Halogeno-platinum compounds (complex co-ordination compounds in which the platinum atom is directly co-ordinated to halide groups) (as Pt)	See page xx	-	0.002	-	-	Sen
Halothane	151-67-7	10	82	-	-	
Hardwood dust	See page xx	-	5	-	-	Carc Sen HSC/E plans to review the limit values for this substance.
<i>n</i> -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
<i>n</i> -Hexane	110-54-3	20	72	-	-	R11, 38, 48/20, 62, 65, 67, 51/53*
1,6-Hexanolactam dust only dust and vapour	105-60-2	- -	1 10	- -	3 20	R20/22, 36/37/38

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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
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	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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 total inhalable	1317-65-3	-	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 total inhalable dust	546-93-0	-	10	-	-	
respirable dust		-	4	-	-	
Magnesium oxide (as Mg) total inhalable dust	1309-48-4	-	10	-	-	
fume and respirable dust		-	4	-	10	
Malathion (ISO)	121-75-5	-	10	-	-	Sk R22, 50/53*

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Maleic anhydride	108-31-6	-	1	-	3	Sen R22, 34, 42/43
Manganese and its inorganic compounds		-	0.5	-	-	
Marble total inhalable respirable	1317-65-3	- -	10 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-Methoxypropylacetate	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

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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	
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	-	-	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
MMMF (Machine-made mineral fibre) (except for Refractory Ceramic Fibres and Special Purpose Fibres)		5 mg.m ⁻³ and 2 fibres/millilitre		-	-	
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	20	72	30	109	Sk R10, 20/21/22, 34
Nickel and its inorganic compounds (except nickel tetracarbonyl): water-soluble nickel compounds (as Ni)		-	0.1	-	-	Sk Carc (nickel oxides and sulphides) Sen (nickel sulphate)
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	2	5.2	4	10	R8, 35
Nitrobenzene	98-95-3	1	5.1	2	10	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	-	-	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Orthophosphoric acid	7664-38-2	-	1	-	2	R34
Osmium tetroxide (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, total 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 total inhalable dust	115-77-5	-	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*
Phenol	108-95-2	2	-	-	-	Sk R23/24/25, 34, 48/20/21/22, 68*
<i>p</i> -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	-	-	0.3	0.42	R12, 17, 26, 34, 50*

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Phosphorus pentachloride	10026-13-8	0.1	0.87	-	-	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 total inhalable dust respirable dust	26499-65-0	- -	10 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 total inhalable dust respirable dust	9002-86-2	- -	10 4	- -	- -	
Portland cement total inhalable dust respirable dust	65997-15-1	- -	10 4	- -	- -	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Potassium hydroxide	1310-58-3	-	-	-	2	R22, 35
Propane-1,2-diol total vapour and particulates particulates	57-55-6	150 -	474 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	
<i>n</i> -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 total inhalable dust respirable dust		- -	10 4	- -	- -	
Pyrethrins (ISO)	8003-34-7 121-21-1 121-29-9	-	5	-	10	R20/21/22, 50/53
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/millilitre	-	-	Carc R49, 38
Resorcinol	108-46-3	10	46	20	92	R22, 36/38, 50

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Rhodium (as Rh) metal fume and dust soluble salts		-	0.1 0.001	-	0.3 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 total inhalable respirable	1309-37-1	- -	10 4	- -	- -	
Rubber fume	See page xx	-	0.6	-	-	Carc Limit relates to cyclohexane soluble material
Rubber process dust	See page xx	-	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 total inhalable dust respirable dust		- -	6 2.4	- -	- -	
Silica, respirable crystalline	see page xx	-	0.3	-	-	HSC/E plans to review the appropriateness of the limit values for this substance.
Silica, fused respirable dust	60676-86-0	-	0.08	-	-	
Silicon total inhalable dust respirable dust	7440-21-3	- -	10 4	- -	- -	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Silicon carbide (not whiskers) total inhalable	409-21-2	-	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 xx	-	5	-	-	Sen HSC/E plans to review the appropriateness of the limit values for this substance.
Starch total inhalable	9005-25-8	-	10	-	-	
respirable		-	4	-	-	
Styrene	100-42-5	100	430	250	1080	R10, 20, 36/38 HSC/E plans to review the appropriateness of the limit values for this substance.
Subtilisins	1395-21-7 (<i>Bacillus subtilis</i> BPN) 9014-01-1 (<i>Bacillus subtilis</i> 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*

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
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	
Tin compounds, organic, except Cyhexatin (ISO), (as Sn)		-	0.1	-	0.2	Sk

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Titanium dioxide total inhalable respirable	13463-67-7	- -	10 4	- -	- -	
Toluene	108-88-3	50	191	150	574	Sk R11, 38, 48/20, 63, 65, 67*
<i>p</i> -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- <i>o</i> -tolyl phosphate	78-30-8	-	0.1	-	0.3	R39/23/24/25, 51/53
Triphenyl phosphate	115-86-6	-	3	-	6	

Substance	CAS Number	Workplace Exposure Limit				Comments
		8-hr limit		15 minute limit		
		ppm	mg.m ⁻³	ppm	mg.m ⁻³	
Tungsten & compounds (as W) soluble compounds insoluble compounds	7440-33-7 and others	- -	1 5	- -	3 10	
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 xx	-	10	-	-	
Xylene, <i>o</i> -, <i>m</i> -, <i>p</i> - 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 total inhalable dust respirable dust	557-05-1	- - -	10 4	- -	20 -	
Zirconium compounds (as Zr)		-	5	-	10	

Annotations

- Carc** Substances that may cause cancer
Substances that may cause heritable genetic damage
Substances that may cause cancer by inhalation
- Sen** Substances capable of causing occupational asthma
- Sk** Substances that can be absorbed through skin. The assigned substances are those for which there are concerns that dermal absorption will lead to systemic toxicity.
- *** classification and labelling for substances marked with an asterisk was introduced in the 29th ATP

Supplementary information for Table 1

Definitions

Cotton dust

- 1 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 expressed into bales.
- 2 The WEL, which is based on personal sampling, applies to exposure to total 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, e.g. garments.

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

- 3 *MDHS14/3: General methods for sampling and gravimetric analysis of respirable and total inhalable dust* 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

- 4 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.

5 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.

6 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 TIP (total inhalable particulate) and RP (respirable particulate). Where identified components of the contamination have WELs these limits will apply.

Flour dust

7 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 (e.g. flour improvers) are included in this definition only after they have been added to the final product mix.

Grain dust

8 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.

9 *EH66: Grain dust* gives further advice on the scope and application of the limit.

Halegono-platinum compounds

10 These are co-ordination compounds in which a platinum atom or ion is directly co-ordinated to one or more halide (i.e. fluoride, chloride, bromide or iodide) ions. These compounds are subject to a WEL. 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 (MMMMF)

11 Machine-made (formerly 'man-made') mineral fibres are divided into four main overlapping categories: mineral wool (rock, glass or slag wool); continuous filament fibre; special purpose or superfine fibre; and Refractory Ceramic Fibre (RCF - see paragraph 15).

12 The WEL for machine-made mineral fibres applies as a gravimetric limit of 5 mg.m⁻³ (8-hour TWA). There are additional WELs expressed as fibres per ml for both RCF and special purpose fibre, and for other MMMF.

13 Other MMMF have a limit of 2 f/ml (8-hour TWA). These are defined as man-made vitreous (silicate) fibres with random orientation with alkaline oxide and alkali earth oxide (Na₂O+K₂O+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 MMMF must be measured or calculated by a method approved by the HSC.

Pulverised fuel ash

14 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)

15 The term 'RCF' also includes non-oxide ceramic fibre such as boron and silicon carbides and nitrides. RCF and special purpose fibre have a limit of 1 f/ml (8-hour TWA). These are defined as man-made vitreous (silicate) fibres with random orientation with alkaline oxide and alkali earth oxide (Na₂O+K₂O+CaO+MgO+BaO) content less than or equal to 18% by weight.

Rubber fume and rubber process

16 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.

17 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*.

18 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 or cured rubber.

19 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.

20 Methods for personal sampling and measurement of total inhalable dusts are available in *MDHS14/3: General methods for sampling and gravimetric analysis of respirable and total inhalable dust* and *MDHS47/2: Determination of rubber*

process dust and rubber fume in air. 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 27 - 30, i.e. dust of any kind when present at a substantial concentration in air is covered by COSHH.

Subtilisins

21 Subtilisins are proteolytic enzymes derived from *Bacillus subtilis*. They are used in biological washing powders and animal feedstuffs but the enzyme preparation used can contain variable amounts of other materials, including other proteases, esterases and non-viable spores. The WEL for subtilisins is 0.00004 (8-hour TWA).

Talc

22 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

23 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.

24 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.

25 The WELs for hardwood dust (total inhalable dust) softwood dust (total inhalable dust) are both 5 mg.m⁻³ 8-hour TWA.

Wool process dust

26 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 bailing 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

27 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 total 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: General principles of protection*, 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.

28 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 'total inhalable' and 'respirable'.

29 **Total 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 total inhalable dust*.

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

Fume

31 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.

• Calculation methods

Calculation of exposure with regard to the specified reference periods

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 [date] 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 2005 and occupational exposure limit for lead as specified in Regulation 2(l) of the Control of Lead at Work Regulations.

Signed
[Name]
 Secretary to the Health and Safety
 Commission
 [Date]

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:

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

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 h 20 min 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 therefore is -

$$\begin{array}{l} 7 \text{ h } 20 \text{ min (7.33 h) at } 0.12 \text{ mg.m}^{-3} \\ 40 \text{ min (0.67 h) at } 0 \text{ mg.m}^{-3} \end{array}$$

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 therefore is -

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

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

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:

<i>Working Period</i>	<i>Exposure (mg.m⁻³)</i>	<i>Duration of sampling (h)</i>
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 therefore is –

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

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

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

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.

<i>Working period</i>	<i>Task</i>	<i>Exposure (mg.m⁻³)</i>
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

Example 5

7 The operator works a 12-hour shift each day for 5 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 is:

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

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

Part 2 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 appropriate action should be taken to ensure that exposure does not exceed three times the short-term limit unless a suitable and sufficient assessment has indicated that such exposures do not present a risk to health.

Examples of how the short-term reference period of 15 minutes is applied.

- (a) Exposure period is less than 15 minutes. The sampling result should be averaged over 15 minutes. For example, if a 5-minute sample produces a level of 600 ppm and is immediately followed by a period of zero exposure, the 15 minute average exposure will be 200 ppm.
- (b) Exposure is longer than 15 minutes. Measurements should be taken over a 15-minute period and the result is the 15-minute average exposure. Measurements for periods of greater than 15 minutes should not be used to calculate a 15-minute average exposure, but if the average exposure over a longer period exceeds the 15-minute exposure limit, then this limit must have been exceeded over some 15-minute period.

For some substances assigned both an 8-hour TWA and a short-term reference period, the total duration of peak exposures above the 8-hour TWA value should be limited to one hour in a 24-hour period, but without prejudice to the generality of the 8-hour TWA.

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

This Appendix reproduces the Notice of Approval which is based on the methods detailed in MDHS59: Man-made mineral fibre. **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 [date] 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 maximum exposure limit specified in the Health and Safety Commission's approved list of maximum exposure limits.

Signed:

[Name]

Secretary to the Health and Safety Commission

[Date]

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 $>5 \mu\text{m}$, average diameter $<3 \mu\text{m}$, 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 to 3 above.