

Thermal Desorption Technical Support

Note 38: Low Occupational Exposure Limit Levels Favouring Workplace Air Analysis by Thermal Desorption – GC(MS)

Recommended to be read in conjunction with TDTS 46

Introduction

Growing awareness of the importance of workplace health and safety and improved knowledge of the potential health impact of personal exposure to chemicals over the long term have caused general lowering of workplace limit levels for inhalation exposure to chemical vapours in recent years. For some particularly hazardous chemicals, limit levels have been reduced below comfortable detection limit thresholds for traditional solvent extraction methods. (See TDTS 46 for an explanation of the differences between solvent extraction and thermal desorption (TD), with respect to analytical sensitivity/detection limits.)

Limit levels are often sub-divided into two categories:

1. 'Maximum' – typically applied to substances which may cause the most serious health effects such as cancer or asthma. Also used for compounds for which there is no known 'safe' level
2. 'Standard' – set at a level below which there are no known risks to human health

In addition to the general trend to lower regulated limits for inhalation exposure, improved understanding of the variability of actual workplace measurement data has also driven down the concentrations of vapours in most workplaces. For example, it is not uncommon for actual personal exposure measurements to vary by nearly two orders of magnitude for a given population of workers all supposedly doing the same task. This is primarily due to differences in behaviour from individual to individual. Given this wide distribution, the only certain way of ensuring

that no-one is exposed to vapour concentrations above the limit level is to keep the mean concentration at or below one tenth of the official limit level.

In the case of 'Maximum' exposure limits (see above), best practice requires concentrations to be kept as low as possible and actual exposures at 1 or 2% of the limit value would be normal in workplaces exercising optimum control.

This TD Technical Support Note tabulates those chemicals with occupational exposure limits at or below 10 ppm which are compatible with analysis by TD-GC(MS). Thermal desorption offers the sensitivity required for monitoring these compounds in workplace air at levels of 0.1 ppm and below. For the most toxic chemicals, with the lowest limit levels, TD is the only feasible analytical option.

Note: *The following table also provides guidance on monitoring methods, for example tube sorbent, trap sorbent, sampling method, safe sampling volume (SSV) and reference publication.*

Note: *Occupational exposure to GC-compatible, vapour-phase organics with higher limit levels can also be carried out efficiently by thermal desorption methods. There is no real upper concentration limit for thermal desorption methods because modern TD technology, such as Markes (ULTRA-) UNITY systems, feature optional single or double splitting for attenuating high level samples. (See instrument brochure).*

Compound	CAS #	Max limit (ppm)	Std limit (ppm)	Sampling method	Sorbent	Comments [Uptake Rates (U) = ng/ppm/min (8 hour) unless stated otherwise]	Reference
Acetic acid	64-19-7		10 _{UK/EU}	Pump	Porapak N	SSV _{500mg} = 50 L	ISO 16017-1
Acrylonitrile	107-13-1		2 _{UK}	Pump or diffusive tube	Porapak N	SSV _{500mg} = 8 L U _{PorN} = 1.35	ISO 16017-1 ISO 16017-2
Allyl alcohol (2-Propen-1-ol)	107-18-6		2 _{UK/EU}	Pump	Chrom 106	Bp 97°C	Mi database
Aniline	62-53-3		1 _{UK/SWE}	Pump	Tenax TA	SSV _{200mg} = 220 L	ISO 16017-1
Benzene	71-43-2		1 _{EU/UK} 0.5 _{SWE}	Pump or diffusive tube	Chrom 106 Carbograph 1 Chrom 106	SSV _{300mg} = 28 L U _{C1TD} = 2.02 (14 d) U _{C106} = 1.72	ISO 16017-1 ISO 16017-2 ISO 16017-2
Benzenethiol	108-98-5		0.5 _{obs UK}	Pump	Tenax TA/inert tube	Bp 169°C	Mi database*
Benzyl chloride	100-44-7		0.5 _{UK} 1 _{SWE}	Pump or diffusive tube	Tenax TA Tenax TA	U _{Tenax} = 2.72	EPA Method TO-17 UK HSL calc.
Bis-chloromethylether	542-88-1		0.001 _{UK} Banned _{SWE}	Pump	Tenax TA/ glass tube	Bp 106°C	Mi database
Bromoform	75-25-2		0.5 _{obs UK}	Pump	Tenax TA	SSV _{200mg} ~ 100 L	Mi TDTS 20
Bromomethane	74-83-9		5 _{UK}	Diffusive	Chrom 106	U _{300mg} = 2.45	UK MDHS 80
1,3-Butadiene	106-99-0		10 _{UK} 0.5 _{SWE}	Pump or diffusive tube	Carbopack X Mol Sieve13X Carbopack X	SSV _{500mg} > 25 L U _{MS13X} = 1.3 U _{CPX} = 1.64	UK MDHS 53 UK MDHS 63 ISO 16017-2
n-Butyl acrylate	141-32-2		1 _{UK} 10 _{SWE}	Diffusive	Tenax TA	U _{TenaxTA} = 2.6	ISO 16017-2
Carbon disulphide	75-15-0	5 _{obs EC}	10 _{UK} 5 _{SWE}	Diffusive	UniCarb	U _{Unicarb} = 2.6	ISO 16017-2
2-Chloroacetophenone	532-27-4		0.05 _{UK}	Pump	Tenax TA	Bp 247°C	Mi database
Chlorobenzene	108-90-07	1 _{UK}	10 _{EU} 5 _{SWE}	Pump	Tenax TA	SSV _{200mg} = 26 L	ISO 16017-1
2-Chloro-1,3-butadiene	126-99-8		10 _{obs UK}	Pump	Chrom 106	Bp 60°C	Mi database*
Chloroform	67-66-3		2 _{UK/EU}	Diffusive	Tenax GR Chrom 102 Chrom 106	U _{TenaxGR} = 2.18 U _{C102} = 2.35 U _{C106} = 2.47	ISO 16017-2 ISO 16017-2 ISO 16017-2
Chlorpyrifos	2921-88-2		0.2 mg.m ⁻³ _{UK}	Pump	Tenax TA/ inert tube	Bp 160°C	Mi TDTS39
Cresols (all isomers)	1319-77-3		5 _{EU} 1 _{SWE}	Pump	Tenax TA	SSV > 3000 L (all isomers)	Mi TDTS 20
Cyclohexanone	108-94-1		10 _{UK/EU/SWE}	Pump	Tenax TA	SSV _{200mg} = 170 L	ISO 16017-1
Cyclohexylamine	108-91-8		10 _{UK/EU} 5 _{SWE}	Pump	Tenax TA/ inert tube	Bp 134°C, semi-quantitative	Mi database*
1,2-Dibromoethane	106-93-4		0.5 _{UK}	Pump	'Air Toxics'	SSV > 5L (@RH < 65%)	EPA Method TO-17
1,2-Dichloroethane	107-06-2		5 _{UK} 1 _{SWE}	Pump or diffusive tube	Chrom 106 Chrom 106 Chrom 102 Tenax GR	SSV _{300mg} = 17 L U _{C106} = 2.03 U _{C102} = 1.9 U _{TenaxGR} = 1.72	ISO 16017-1 UK HSL calc. ISO 16017-2 UK HSL calc.
Dichlorofluoromethane	75-43-4		10 _{UK}	Pump	UniCarb	Bp 8.9°C	Mi database
Dichlorvos	62-73-7		0.1 _{obs UK}	Pump	Quartz wool & Tenax TA in a glass tube	Bp 234°C	Mi TDTS 39
Dicyclopentadiene	77-73-6		5 _{UK}	Pump	Tenax TA	Bp 170°C	Mi database

Compound	CAS #	Max limit (ppm)	Std limit (ppm)	Sampling method	Sorbent	Comments [Uptake Rates (U) = ng/ppm/min (8 hour) unless stated otherwise]	Reference
Diethylamine	109-89-7		10 _{UK} 5 _{EU} 10 _{SWE}	Pump	Chrom 106 or Porapak N/ inert tube	Bp 55°C, semi-quantitative	Mi database*
Diethyl phthalate	84-66-2		5 mg.m ⁻³ _{UK}	Pump	Quartz wool & Tenax TA	Bp 295°C	Mi TDTS 35
Diisobutylphthalate	84-69-5		5 mg.m ⁻³ _{UK}	Pump	Quartz wool & Tenax TA	Bp 296°C	Mi TDTS 35
Diisodecylphthalate	26761-40-0		5 mg.m ⁻³ _{UK}	Pump	Quartz wool & Tenax TA	Bp 250°C	Mi TDTS 35
Diisononylphthalate	28553-12-0		5 mg.m ⁻³ _{UK}	Pump	Quartz wool & Tenax TA	Bp 270-280°C @ 13 mBar	Mi TDTS 35
Diisooctylphthalate	27554-26-3		5 mg.m ⁻³ _{UK}	Pump	Quartz wool & Tenax TA	Bp 370°C	Mi TDTS 35
Diethyl sulphate	64-67-5		0.05 _{UK}	Pump	Tenax TA	SSV _{200mg} >96 L	UK HSL MDHS 96
Diisopropylamine	108-18-9		5 _{UK} 5 _{SWE}	Pump	Chrom 106 or Porapak N	Bp 84°C	Mi database
N,N-Dimethylacetamide	127-19-5		10 _{UK/EU} 10 _{SWE}	Pump	Tenax TA	Bp 165°C	Mi database
Dimethylamine	124-40-3		2 _{UK} 2 _{SWE} 2 _{EU}	Pump	UniCarb/ inert tube	Bp 7°C, semi-quantitative	Mi database*
N,N-Dimethylethylamine	598-56-1		10 _{UK}	Pump	Chrom 106/ inert tube	Bp 36.5°C	Mi database*
Dimethylformamide	68-12-2		10 _{UK}	Pump	Tenax TA	Bp 153°C	EPA Method TO-17
Dimethyl sulphate	77-78-1		0.05 _{UK}	Pump	Tenax TA	SSV _{200mg} >96 L	UK HSL MDHS 96
Dinitrobenzene	25154-54-5		0.15 _{UK}	Pump	Tenax TA	Bp 320°C @ 1 bar	Mi database
Diphenylether	101-84-8		1 _{UK}	Pump	Tenax TA	Bp 258°	Mi database
Divinyl benzene	1321-74-0		10 _{obs UK}	Pump	Tenax TA	Bp 121°C @ 76 mm Hg	Mi database
Epichlorohydrin [1-Chloro-2,3-epoxypropane]	106-89-8		0.5 _{UK}	Diffusive	Chrom 106	U _{C106} = 2.45	ISO 16017-2
Ethanthiol	75-08-1		0.5 _{UK}	Pump	Chrom 106/ glass tube	Bp 35°C	EPA Method TO-17
2-Ethoxyethanol	110-80-5		10 _{UK} 2 _{EU}	Pump or diffusive tube	Chrom 106 Tenax TA	SSV _{300mg} =75 L U _{TenaxTA} = 1.8	ISO 16017-1 ISO 16017-2
2-Ethoxyethyl acetate	111-15-9		10 _{UK} 2 _{EU}	Pump or diffusive tube	Tenax TA Chrom 106 Tenax TA Chrom 106	SSV _{200mg} = 15 L SSV _{300mg} = 4000 L U _{TenaxTA} = 2.1 U _{C106} = 2.3	ISO 16017-1 ISO 16017-1 ISO 16017-2 ISO 16017-2
Ethyl acrylate	140-88-5		5 _{UK}	Pump	Tenax	SSV _{200mg} = 24 L	ISO 16017-1
Ethylamine	75-04-7		2 _{UK} 5 _{EU}	Pump	Chrom 106 or UniCarb/ inert tube	Bp 16°C	Mi database*

Compound	CAS #	Max limit (ppm)	Std limit (ppm)	Sampling method	Sorbent	Comments [Uptake Rates (U) = ng/ppm/min (8 hour) unless stated otherwise]	Reference
Ethylene dinitrate	628-96-6		0.2 _{obs UK}	Pump	Tenax TA/ inert tube	Bp 199°C	Mi database*
Ethylene oxide	75-21-8		5 _{UK} 1 _{SWE}	Pump or diffusive tube	Carboxen 569 UniCarb	SSV _{C569} = 70 L U _{UniCarb} = 1.6	16017-1 16017-2
4-Ethylmorpholine	100-74-3		5 _{UK}	Pump	Tenax TA	Bp 139°C	Mi database
Furfural	98-01-1		2 _{UK} 2 _{SWE}	Pump or diffusive tube	Tenax TA Tenax TA	SSV _{200mg} = 300 L U _{TenaxTA} = 2.5	ISO 16017-1 ISO 16017-2
Furfuryl alcohol	98-00-0		5 _{obs UK} 5 _{SWE}	Diffusive	Tenax TA	U _{TenaxTA} = 2.5	UK HSL calc.
Halothane	151-67-7		10 _{UK} 5 _{SWE}	Diffusive	Tenax TA	U _{TenaxTA} = 2.59	ISO 16017-1
Hexachloroethane	67-72-1		5 _{obs UK}	Pump	Tenax TA	Bp 185°C	Mi database
Hexan-2-one	591-78-6		5 _{UK} 1 _{SWE}	Pump	Tenax TA	Bp 128°	Mi database
Hydrogen sulphide			5 _{UK} 10 _{SWE}	Online/ canister	'H ₂ S' trap		Mi TDTS 32
2-Hydroxypropyl acrylate	999-61-1		0.5 _{UK} 1 _{SWE}	Pump	Tenax TA	77°C @ 5 mm Hg, semi-quantitative	Mi database*
Indene	95-13-6		10 _{UK}	Pump	Tenax TA	Bp 182°C	EPA Method TO-17
Iodoform	75-47-8		0.6 _{UK}	Pump	Tenax TA	Bp 218°C	Mi database
Iodomethane	74-88-4		2 _{UK}	Pump	UniCarb	Bp 43°C	Mi database
Methacrylonitrile	126-98-7		1 _{UK}	Pump	Tenax TA	Bp 90°C	Mi database
Methanethiol	74-93-1		0.5 _{UK} 1 _{SWE}	Pump	UniCarb/ inert tube	Bp 6°C	EPA Method TO-17
2-Methoxy ethanol	106-86-4		5 _{UK}	Pump or diffusive tube	Chrom 106 Chrom 106 Porapak Q	SSV _{300mg} = 300 L U _{C106} = 2.1 U _{PorQ} = 1.5	ISO 16017-1 ISO 16017-2 ISO 16017-2
Methoxyethyl acetate	110-49-6		5 _{UK}	Pump or diffusive tube	Chrom 106 Porapak Q	SSV _{300mg} = 860 L U _{PorQ} = 2.8	ISO 16017-1 ISO 16017-2
Methyl acrylate	96-33-3		10 _{obs UK} 10 _{SWE}	Pump	Chrom 106 Tenax TA	SSV _{200mg} = 6.5 L	EPA Method TO-17 ISO 16017-1
Methylamine	74-89-5		10 _{obs UK} 10 _{SWE}	Pump	UniCarb	Bp -6°C	Mi database
n-Methylaniline	100-61-8		0.5 _{UK}	Pump	Tenax TA	Bp 196°C, semi-quantitative	Mi database*
5-Methylheptan-3-one	541-85-5		10 _{UK/EU}	Pump	Tenax	Bp 159°C	Mi database

Compound	CAS #	Max limit (ppm)	Std limit (ppm)	Sampling method	Sorbent	Comments (Uptake Rates (U) = ng/ppm/min (8 hour) unless stated otherwise)	Reference
Mevinphos	7786-34-7		0.01 _{obs UK}	Pump	Quartz wool/ Tenax TA in a glass tube	99 - 103°C @ 0.3 mm Hg	Mi database*
Naphthalene	91-20-3		10 _{SWE} 10 _{EU}	Pump	Tenax TA	Bp 218°C	EPA Method TO-17
Nitrobenzene	98-95-3		0.2 _{UK/EU} 1 _{SWE}	Pump	Tenax TA	SSV _{200mg} = 14 kL	ISO 16017-1
Nitrotoluene (all isomers)			5 _{obs UK} 1 _{SWE}	Pump	Tenax TA	Bp 222°C	Mi database
Phenol	108-95-2		2 _{UK/EU} 1 _{SWE}	Pump	Tenax TA	SSV _{200mg} = 240 L	ISO 16017-1
Phenyl-2,3-epoxypropyl ether	122-60-1		1 _{obs UK}	Pump	Tenax TA	Bp 243°C	Mi database
Piperazine	110-85-0		0.1 _{EU} 0.1 mg.m ⁻³ _{UK}	Pump	Tenax TA/ inert tube	Bp 295°C, semi-quantitative	Mi database*
Piperidine	110-89-4		1 _{UK}	Pump	Tenax TA	Bp 106°C	Mi database*
Propionic acid	79-09-4		10 _{UK/EU}	Pump	Tenax TA	Bp 141°C	Mi database*
Propylene oxide	75-56-9		5 _{UK} 2 _{SWE}	Pump or diffusive tube	Chrom 106	SSV _{300mg} = 1 L U _{C106} = 1.24	ISO 16017-1 MDHS 80
Pyridine	110-86-1		5 _{UK/EU} 1 _{SWE}	Pump	Tenax TA Porapak N	SSV _{200mg} = 8 L SSV _{500mg} = 200 L	EPA Method TO-17 ISO 16017-1
2-Pyridylamine	504-29-0		0.5 _{UK/EU}	Pump	Tenax TA	Bp 211°C	NIOSH S158
Pyrocatechol [1,2-Benzenediol]	120-80-9		5 _{UK}	Pump	Tenax TA/ inert tube	Bp 245°C	Mi database*
Resorcinol [1,3-Benzenediol]	108-46-3		10 _{UK/EU} 10 _{SWE}	Pump	Tenax TA	Bp 280°C	Mi database
1,1,2,2-Tetrabromoethane	79-27-6		0.5 _{UK} 1 _{SWE}	Pump	Tenax TA	Bp 244°C	Mi database
Tetrabromomethane [Carbon tetrabromide]	558-13-4		0.1 _{obs UK}	Pump	Tenax TA	Bp 190°C	Mi database
Tetrachloromethane [Carbon tetrachloride]	56-23-5		2 _{UK}	Pump or diffusive tube	Tenax TA Chrom 106 Tenax GR Chrom 102	SSV _{200mg} = 6.2 L SSV _{300mg} = 22 L U _{TenaxGR} = 3.72 U _{C102} = 2.87	ISO 16017-1 ISO 16017-1 ISO 16017-2 ISO 16017-2
o-Toluidine	95-53-4		0.2 _{UK}	Pump	Tenax TA	Bp 200°C	Mi database
1,2,4-Trichlorobenzene	120-82-1		1 _{UK} 2 _{obs EU}	Pump	'Air Toxics'	SSV >5 L (@RH <65%)	EPA Method TO-17
Trichloronitromethane	76-06-2		0.1 _{UK}	Pump	Tenax TA	Bp 112°C	Mi database
Triethylamine	121-44-8		2 _{UK/EU}	Pump	Chrom 106/ inert tube	Bp 89°C	Mi database
Trimethylamine	75-50-3		10 _{obs UK}	Pump	UniCarb/ inert tube	Bp 3°C	Mi database
Vinyl acetate	108-05-4		10 _{obs UK} 5 _{SWE}	Pump or diffusive tube	Chrom 106 Chrom 106	U _{300mg} = 1.93	EPA Method TO-17 UK HSL calc
Vinyl chloride	75-01-4		3 _{UK} 1 _{SWE}	Diffusive	UniCarb	U _{UniCarb} = 2.0	ISO 16017-2
Vinylidene chloride	75-35-4		10 _{UK}	Pump or diffusive tube	Carboxen 1000 UniCarb	SSV >75 L (@RH <65%) U _{UniCarb} = 2.5	EPA Method TO-17 ISO 16017-2

Obs UK = Obsolete UK value
Obs EC = Obsolete EC value

*=no quantitative field validation available (may be semi-quantitative only). Recommendations are based on best advice and experience with similar compounds

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