BIGNEAT
CHEMCAP™ FILTERS

CHEMICAL LISTING
with
Guidelines to Retention Capacities
& Safety Monitoring of Chemcap Filters

2004 CD VERSION

BIGNEAT CHEMCAP™ FILTERS

In excess of 30,000 filtered air safety enclosures, mainly ductless fume cabinets and robotic enclosures, are currently in use in the UK. To provide these enclosures with the highest possible standard of air filtration Bigneat has developed a new range of carbon filters under the Chemcap™ name. Together with their outstanding filtration performance, Chemcap™ filters are free of toxic and environmentally harmful chemical impregnants, which are used in other brands of filter, for example (hexavalent chromium and copper (II) chloride).

Recognising this issue, Bigneat made the decision several years ago to develop a range of filters, which maintain superior standards of retention performance without the use of harmful impregnants. The Chemcap™ product range is designed to meet demanding international standards relating to personnel safety in use, and the environment when used filters are sent for disposal.

Development work for Chemcap™ filters was carried out in association with the University of Portsmouth, whose laboratories and personnel have been involved with research into porous carbon solids for almost 40 years.

Activated carbon, the adsorbent of choice in filters is used for air treatment for a wide variety of filtration applications, from fume cabinets to robotics enclosures, providing manufacturing and pharmaceutical industries with a wealth of safe processing possibilities.
In the form of activated carbon, the element provides a remarkable, high surface area, acting as a high porosity 'molecular sponge', with an almost limitless range of uses as a purifier of liquids and gases.

Activated carbon derived from coconut shell is used in the majority of the Chemcap™ filter range. This type gives outstanding performance in gas purification due to its high proportion of micropores (radius < 1 nm) and its potential for surface area development without excessive dust production. The specific surface area of carbons used in the Chemcap™ filter range is of the order of 1300 square metres per gram.

In the absence of chemical impregnants, activated carbon is capable of retaining a wide range of organic chemical vapours, together with some mineral acids. However, retention of a broad spectrum of acids, alkalis and species such as formaldehyde necessitates the incorporation of specialised chemicals into the carbon.

The development of the Bigneat Chemcap™ filter range was carried out with regard to a number of very important criteria, namely:

- filters had to give high retention capacity at all air flow rates likely to be encountered with the Bigneat range of ductless fume hoods and specialist robotics enclosures;
- chemical treatments for enhanced acid or alkali retention had to be non-hazardous to operatives undertaking the carbon impregnation work, to personnel handling and using the filters, and to the environment when used filters are sent for landfill or other disposal methods;
- when used in conjunction with the Bigneat range of ductless fume hoods, filtration performance had to conform to the requirements of internationally recognised test procedures, such as AFNOR NF X 15-211and BS 7989:2001
- rigorous quality control procedures had to be developed for all stages of filter production, including activated carbon manufacture, chemical treatment stages, and the performance of the final filter product.

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In the course of Chemcap™ filter development work, the performance of carbons, filters and fume hoods has been assessed with more than 200 different challenge chemicals. Chemcap™ filters currently in use provide outstanding retention capacities for organic chemical vapours (type OS), acids (type H+), and alkalis (type AM). In addition, MP filters provide excellent all-round performance in circumstances where solvents, acids and alkalis are used in the enclosure. Type F is a special filter for formaldehyde retention.

Bigneat's new cabinet range, in combination with Chemcap™ filtration, offers effective containment and high levels of operator safety. This is demonstrated through their assessment against international standards using the French AFNOR test and the British Standard for ductless fume hoods

AFNOR NF X 15-211

This standard, for enclosures of Class 2, requires that their filtration performance be assessed in two phases of operation.

In *Phase 1*, normal operation, the amount of challenge material retained by the filtration system is determined at the point at which the concentration of the material in the exhaust gases reaches 1 % of the VME for that material.

In *Phase 2*, the detection phase, the additional amount of toxic material retained by the filtration system is determined at the point at which the concentration of the chemical challenge in the exhaust gases reaches 50 % of the VME. A challenge concentration of 200 ppm in the air stream is required throughout the test.

With propan-2-ol as the challenge, the Bigneat Chemcap™ system gave a retention capacity of 350 grams in *Phase 1* and additional 1130 grams retention in *Phase 2.*

BS 7989:2001

British Standard 7989:2001 requires a capacity type test to be carried out, using propan-2-ol as challenge at a much higher concentration than in the AFNOR test, i.e. 800 ppm compared to 200 ppm. The Bigneat enclosure, fitted with a Chemcap™ OS filter, comfortably met the requirement that no more than 40 ppm of the solvent should be emitted with the exhaust gas during the evaporation of 1 litre of solvent, and that no more than 400 ppm should be emitted during the evaporation of 2 litres of solvent.

The excellent performance of current Chemcap™ filter is backed up by a policy of continuous product development, and the company is very willing to discuss special filtration requirements with clients.

GUIDELINES TO SELECTING CHEMCAP™ FILTERS

It is important to carry out a risk assessment to identify the predominant vapour and/or particulate that is to be filtered. The following table outlines the groups from which an initial selection should be made, in conjunction with the detailed Retention Capacities Listings on the subsequent pages:

Choice of ChemCap™ Filters				
Type of vapour being handled	A		B*	
	Chemicals without particulates		Chemicals with particulates	
ORGANIC VAPOURS Secondary acids	Carbon Filter	OS	Filter set	OS & HEPA
ACID VAPOURS Secondary organic vapours	Carbon Filter	H+	Filter set	H+ & HEPA
FORMALDEHYDE	Carbon Filter	F	Filter set	FP & HEPA
AMMONIA	Carbon Filter	AM	Filter set	AMP & HEPA
Mixed ORGANICS & INORGANICS			MP Filter	

- Filter type ‘OS’ is used where organic vapours predominates
- Filter type ‘H+’ use for handlings where acid vapours predominate
- Filter type ‘F’ must be used when formaldehyde predominates
- Filter type ‘AM’ is used when ammonia predominates
- Filter type ‘Ri’ must be used with radioactive iodine

* Additional HEPA Filters must be used for these applications where the size of particulate matter is smaller than 5 microns, as shown in column ‘B’

GUIDELINES FOR SAFETY MONITORING & TESTING OF CARBON FILTERS

Introduction

In order to clarify the best practise for the use of Bigneat Chemcap™ carbon filters the following guidelines are advised.

FILTER TECHNOLOGY

Activated carbon will adsorb any chemical with a molecular weight above 30 and a boiling point above 60^{o}C. Some compounds, which do not fall into this bracket, are also well adsorbed because of their molecular size and structure (e.g. acetylene). However to achieve optimum filtration efficiency and capacity, important design criteria must be met by the filtration equipment.

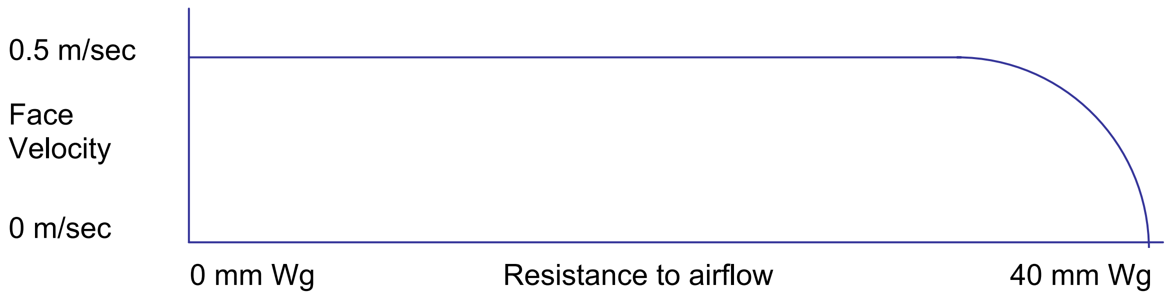
FILTRATION EFFICIENCY AND CAPACITY

The carbon filter beds require a residence time of the vapour within the filter bed of 0.1 seconds and a linear air velocity of less than 0.5 m/s to ensure high filter efficiency and adsorption of the vapour, and a bed size of 13.5kg per 1000m^3/hr airflow to ensure adequate filter capacity.

All Bigneat units employing carbon filtration have been designed to provide a residence (or dwell) time of vapour within the filter bed greater than 0.3 seconds, a linear velocity of 0.3 m/s. This all leads to units which offer a combination of high filtration efficiency and long filter life.

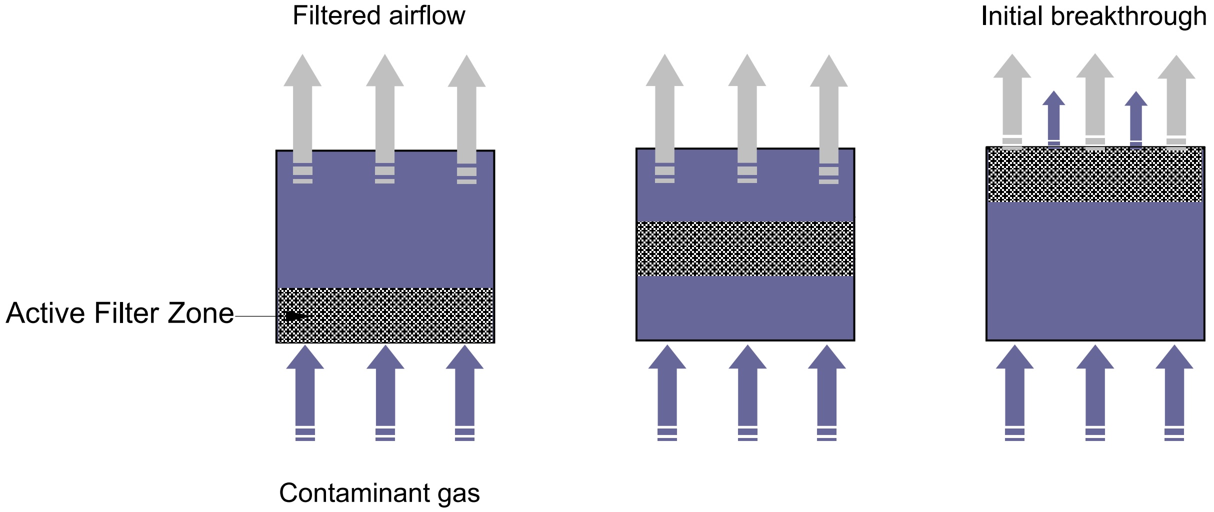
FILTER MONITORING

There are two main aspects of filter monitoring, these are: a check of the airflow to ensure the pre filter is not clogged with dust: a check of the exhaust air for chemical contaminants which may breakthrough if the main filter bed has reached its breakthrough saturation point. Airflow should be measured with a precision anemometer. The use of high quality centrifugal fans and control systems ensure that airflow is maintained even as the pre-filter airflow resistance increases.

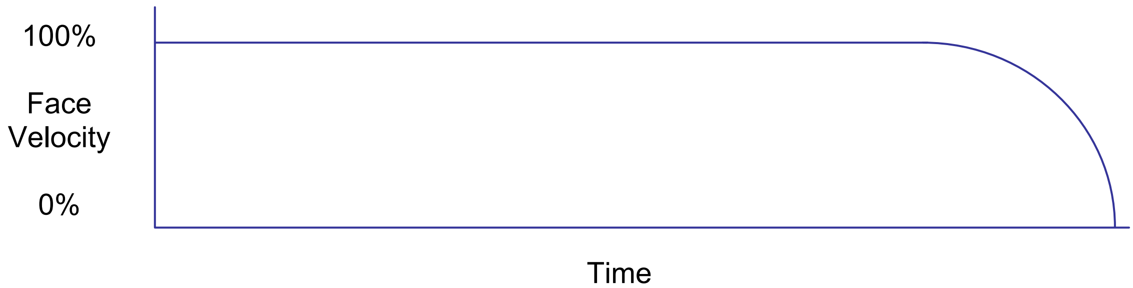


FILTER MONITORING Cont.

Adsorption takes places in the filter bed in what is known as the *Active filter zone.* This is a small cross section of the filter bed, and as the filter becomes saturated, this active zone progressively moves up the filter bed until it approaches the top surface of the filter. At this point there is an initial breakthrough by the contaminant gas, and thereafter the percentage of contaminant gas that escapes filtration increases until total saturation of the filter is reached. This is shown below



Filter monitoring should aim to detect the period between initial breakthrough and the point at which the contaminant gas reaches the Occupational Exposure Limit (O.E.L) for that substance.



Filter monitoring can be performed with gas detection tubes such as the Draeger™ or Gastec™. The filter is challenged with a known chemical, and the concentration of this chemical in the exhaust air is measured with a suitable detection tube.

Ensure the unit is switched on and confirm airflow is correct by measurement or examination of the low airflow alarm.
Introduce the chemical challenge that is normally in use within the unit or a less harmful equivalent e.g. Iso Propyl Alcohol (IPA)

Test the exhaust filter or the filter test port to confirm there is no evidence of the chemical.

If the challenge chemical is detected then the follow actions should be taken:

FILTER MONITORING Cont.

1. Ensure there are no gaps in the filter seal
2. Check that the filter is fitted correctly with the seal seated and evenly compressed
3. Change the filter and retest

The result should be recorded in a logbook, a legal requirement under section 9 of the Control of Substances hazardous to Health (COSHH) regulations.

Fume filtration cupboards are not recommended for use where very large quantities of contaminants are produced and released, such as in acid digestions or evaporation of solvents to dryness. Nor are they advised for applications where highly toxic substances are in use.

TEST, MONITOR & CHANGE PERIODS

The *test period* is the maximum period between the filter installation test and the next test for contaminant breakthrough of the filter, some applications where heavier loads of chemicals are applied or the chemicals are dangerous then filter testing should be completed monthly or even weekly.

The *monitor period* is the maximum period between the filter installation test and regular weekly / monthly filter monitoring for contaminant breakthrough of the filter.

The *change period* is the maximum period between the filter installation test and the time to change the filter to avoid contaminant breakthrough of the filter.

In all the periods, *test, monitor, and change,* the time scale of the period is expressed in months. This is dependant on the assumption that the unit is in use for an 8 hr day / 40 hr week. Therefore, in units of higher usage the number of hours run will supersede the monthly recommendation.

Note the *test, monitor, and change,* should be completed at the earliest point whether this be, for example, 6 months or 1000 hrs which ever occurs sooner, also it must be noted that once carbon filters have been opened and exposed they will absorb water from the atmosphere. Therefore after 24 months the filters potential life and efficiency cannot be assured and therefore the filters should be replaced or discarded if in storage.

TEST, MONITOR & CHANGE PERIODS

The filter test protocol mentioned briefly earlier in this document should be applied during all *test, monitor, and change,* stages. This is to identify and confirm that the filter is fitted correctly and is adsorbing the contaminant breakthrough of the filter as intended.
It is best to regard the *test, monitor, change,* and time scales as the maximum allowed.

GUIDELINE RETENTION CAPACITIES OF CHEMCAP™ FILTERS AT 50% OF TLV OR VME OR MAK
* indicates suitable filter

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV /ppm	OS Filter /g	H+ Filter /g	F Filter /g	MP Filter /g	Safety Notes
Acetaldehyde	44.05	21	100	300	220		250	
Acetic acid, glacial	60.05	118	10	1500	960		1120	
Acetic anhydride	102.09	139	5	1650	1060		1200	
Acetone	58.08	56.5	750	480	340		450	
Acetonitrile	41.05	81.6	40	320	230		280	
Acetophenone	120.15	202		1800			1400	
Acetonylacetone (2,5-hexanedione)	114.14	188		1500			1200	
Acetylacetone (2,4-pentanedione)	100.11	140.5		1700			1500	
Acetyl chloride	78.50	52		600			450	
Acetylene	26.02							Not recommended
Acetylene dibromide	185.87	-		850			600	
Acetylene dichloride	96.95	55	200	700			540	
Acetylene tetrabromide (tetrabromoethane)	345.70	151	1	3300			2650	
Acetylene tetrachloride (tetrachloroethane)	167.86	146.5	5	3100			2600	
Acrolein	56.06	52.5	0.1					Not recommended
Acrylic acid	72.06	141	10	1320	940		1050	
Acrylonitrile	53.06	77.3	2	260	190		200	
Alkyd resins				*				
Allyl alcohol	58.08	96	2	570	410		440	
Allyl bromide	120.99	71.3	1	630	450		500	
Allyl chloride	76.53	44.5	1	500	350		400	
Allyl sulphide	114.20	139		850			500	
i-Amyl alcohol	88.15	119.3		1200	850		880	
n-Amyl alcohol	88.15	137		1120	830		900	
n-Amyl acetate	130.19	149.3	100	1320	940		960	
i-Amyl acetate	130.19	142	125	1250	890		1100	
n-Amyl ether	158.28	186.8		1700			1450	
Aniline	93.12	185	2	1550	1150		1250	
Benzal chloride	161.03	205		1700			1300	
Benzaldehyde	106.12	179		960	680		720	
Benzene	78.11	80.1	0.1	720	510		700	Restrict to 250 g maximum due to high toxicity
Benzenethiol (thiophenol)	110.17	168	0.5		*			
Bezoyl chloride	140.57	197	1	1250			950	
Benzyl acetate	150.17	213		*				
Benzyl alcohol	108.13	205		*				
Benzylamine	107.15	185		1000			750	
Benzyl chloride	126.58	179	1	850	600		650	
Bromoacetic acid	138.96	208		*	*			
Bromobenzene	157.02	156.2		1600	1150		1050	
Bromoethane (ethyl bromide)	108.98	38.2	5	920	650		730	
Bromoform (tribromomethane)	252.77	149.5	0.5	850	590		650	
Butanoic acid	88.10	164	1700	1400			1350	
n-Butanol	74.12	117.5	100	1050	750		840	
2-Butanol	74.12	99.5	150	880	620		700	
t-Butanol (2-methyl-2-propanol)	74.12	82.4	100	880	660		720	
n-Butyl acetate	116.16	125	150	1040	750		990	

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV /ppm	OS Filter /g	H+ Filter /g	F Filter /g	MP Filter /g	Safety Notes
sec-Butyl acetate	116.16	112.5	200	980	700		780	
t-Butyl acetate	116.16	97.8	200	900	650		720	
n-Butyl acrylate	128.17	145	10	1050	780		800	
n-Butylamine	73.14	78	5	170	120		130	
Sec-Butylamine	73.14	63		140	100		110	
t-Butylamine	73.14	45		100	70		80	
n-Butyl bromide	137.03	101		*			*	
sec-Butyl bromide	137.03	91		*			*	
t-Butyl bromide	137.03	73		*			*	
Butyl cellosolve (2-butoxyethanol)	118.17	172	25	1750	1400		1300	
n-Butyl chloride	92.57	78.5		620	440		500	
2-Butyl chloride	92.57	68		550	380		440	
t-Butyl chloride	92.57	51		400	280		330	
n-Butyl ether	130.22	142.5		1040	750		850	
t-Butyl methyl ether	88.15	55.2		720	520		660	
Butyraldehyde	72.10	74.8		550	450		450	
Camphor	152.23	204	2	*			*	
Caproic acid	116.16	205		*			*	
Caprylic acid	144.21	240		*			*	
Carbitol	134.17	219		1650			1300	
Carbon disulphide	76.14	46.5	10	320	230		320	
Carbon tetrabromide	331.63	189.5	0.1	1250	890		970	High toxicity
Carbon tetrachloride	153.84	76.7	5	1600	1150		1450	High toxicity
Chloroacetaldehyde	78.50	86	1	550	350		350	
Chlorobenzene	112.56	131.5	75	1625	1100		1250	
Chlorobutanol	177.47	167		*			*	
Chloroform	119.39	61	10	920	650		900	
1-Chlorohexane	120.62	134		1600	*		*	
Chloromethyl methyl ether	80.51	59		*			*	
o-Chlorotoluene	126.58	159	50	1900	1340		1550	
m-Chlorotoluene	126.58	162		1950	1400		1550	
p-Chlorotoluene	126.58	162		1950	1400		1550	
Cresol (*o, m and p*)	138.16	195-205	5	1250	1000		850	
Crotonaldehyde	70.09	104	2	750	550		600	
Cumene	120.19	153	50	1300	1000		950	
Cumic acid	164.20	116		*	*			
Cumidine	148.20	236	2	*			*	
Cyclohexane	84.16	80.7	300	960	680		900	
Cyclohexene	82.14	83	300	1350	900		950	
Cyclohexanol	100.16	161	50	1420	1000		1100	
Cyclohexanone	98.16	155.6	25	1,000	720		850	
Cyclohexylamine	99.17	134.5	10	550	380		420	
Cyclopentadiene	66.10	42	75	600	400		400	
Cyclopentane	70.13	49	600	700	500		500	
Cyclopentane	70.13	49.3	600	720	520	-	560	
2.4 D	221.04	Decomp.		*			*	
DDT	350.46			*			*	
Decane	142.28	174		1250	900	-	1000	
Diacetone alcohol	116.16	168	50	1050			850	
1,2-Diamino ethane (ethylene diamine)	60.11	116.5	10	1100	780		1480	
Dibromobenzene	235.92	220		1900			1600	
1,2-Dibromoethane	187.88	132		1450			1100	
Dibutyl phosphate	210.10		1	*			*	
Dichloroacetic acid	128.95	194		1300	1400		*	
3,4-Dichloroaniline	162.03	272		*			*	

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV /ppm	OS Filter /g	H+ Filter /g	F Filter /g	MP Filter /g	Safety Notes
1,2-Dichlorobenzene	147.01	180.5	25	2120	1500	-	1760	
1,1-Dichloroethane	98.96	57	100	400	320	-	330	
1,2-Dichloroethane	98.96	83.5	10	1050	750	-	860	
1,2-Dichloroethylene	96.94	60.3	200	1500	1070	-	1260	
Sym-Dichloroethylether	143.02	178	5	400			300	
Dichloromethane	84.94	39.8	50	320	220		275	
Dichloromethyl ether	114.97	106	0.001					High toxicity. Not recommended
Dicyclopentadiene	132.21	170	5	1140	820		910	
Dieldrin	380.93				*		*	
Diethanolamine	105.14	268.8	3	710	490		560	
Diethylamine	73.14	55.5	10	340	240		280	
2-Diethyl amino ethanol	117.19	163	10	900	750		700	
Diethyl carbonate	118.30	126		950	670		760	
Diethyl ether	74.12	34.6	400	560	400		500	
Diethyl ketone	86.13	101.5	200	1250	880		1000	
Diethyl sulphate	154.19	210		*			*	
Difluorodibromoethane	210.05	23	100	*			*	
Diisoamylamine	157.29	188		*			*	
Diisobutyl ketone	142.10	166	25	1150	900			
Di-isopropylamine	101.19	84	5	1000	825		715	
Diisopropyl ketone	114.20	124	50	1200	900		850	
Dimethyl formamide	73.09	153	10	1500	1375		1400	
Dimethyl sulphate	126.13	188	0.1	1250	890		1000	High toxicity Restrict to 500 g
Dimethyl sulphoxide DMSO	78.13	189		1600	1870		1430	
Dioxane	88.10	101.1	25	1150	820		900	
Diphenylamine	169.22	302		*				
Divinyl benzene	130.1	198	10	1250	950			
Ethanolamine	68.08	170.5	3	300	220		440	
Ethyl acetate	88.10	77	400	900	640		820	
Ethyl acetoacetate	130.14	181		1200	1000		1050	
Ethyl alcohol	46.07	78.5	1000	500	380		440	
Ethyl amyl ketone	128.21	159	25	1000	750		800	
Ethyl benzene	106.16	136.3	100	1560	1110		1250	
Ethyl butyl ketone	114.2	148	50	*				
Ethyl chloroacetate	122.55	145		2050	850		700	
Ethyl chloroformate	108.53	95		1850	750		550	
Ethylene carbonate	79.96	248		*				
Ethylene diamine	60.10	228	10	*				
Ethyl formate	74.08	54	100	550	*		*	
Ethyl iodide	155.98	72	500	850	*		*	
Ethylene glycol	62.07	197.6	50	900	650		700	
Formaldehyde in 37 % aq. solution	30.03	96	0.3	150	-	350		
Formic acid	46.02	100.5	5	1540	350		450	
Furfural	96.08	162	2	800	*		*	
Furfuryl alcohol	98.10	170	10	900	650		700	
Gallic acid	170.12			*				
Gasoline	Range	30-200	300	*				
Glutaraldehyde, 50 %	100.11	188	0.2	250				
Glycidol	74.08	167	25	1800	1400		1400	
Heptanal (heptaldehyde)	114.18	153	100	550	*		*	
n-Heptane	100.20	98.4	400	1150	820		960	
Heptanoic acid	130.18	223		1800				
1-Heptanol	116.20	174		*				

Chemical name	Relative Molecular Mass	Boiling Point/ °C	TLV /ppm	OS Filter /g	H+ Filter /g	F Filter /g	MP Filter /g	Safety Notes
2-Heptanol	116.20	73.5		*				
2-Heptanone	116.20	152	100	*				
Hexachloroethane	236.74	187	1	*				
n-Hexane	86.17	69	50	980	700		825	
Sec-Hexyl acetate	144.1	146	50	1350	*		*	
Indene	116.15	182	10	*				
Indole	117.14	253		*				
Industrial methylated spririts	-	64-79	200	400	280		340	
Iodoform	393.78		0.6	*				
Isophorone	138.20	215	5	1350	1000	950		
Isoprene	68.11	34		350	200		200	
Isopropylamine	59.08	34	5	200	*		*	
Isopropyl bromide	123.00	59		450	*		*	
Isopropyl chloride	78.54	36		200	*		*	
Isopropyl ether	102.17	69	250	700	550		500	
Lactic acid	90.08			*				
Malathion	330.36	156.5		*				
Menthol	156.26	212		*				
2-Mercaptoethanol	78.13	158			*			
Mesityl oxide	98.14	130	15	1150	950		900	
Mesitylene 1,3,5-trimethyl benzene)	120.2	164.7	25	1250	890		1000	
Methacrylic acid	86.09	163	20	*	*			
Methyl acetate	74	58	200	500	350		400	
Methyl alcohol	32.04	64.7	200	100	70		100	
Methyl acrylate	86.09	66	10	*	*			
Methyl bromide	94.95	3.6	5	*				Small retention only
Methyl butyl ketone	100.16	127	5	850	640		670	
Methyl cellosolve (2-methoxy ethanol)	76.09	124	5	1250	900		1000	
Methyl chloroform	133.40	74.1	350	850	650		*	
Methyl cyclohexane	98.19	101	400	1000	750		*	
Methyl cyclohexanol	114.19	155-180	50	1350	1000		1000	
Methylene bromide	173.86	97	50	300	220			
Methylene chloride	84.94	40	50	200	120			
Methylene iodide	267.87	181		450	*		*	
Methyl ethyl ketone	72.10	79.6	200	910	650		800	
Methyl formate	60.05	31.5	100	<100	<100		<100	
Methyl isobutyl ketone	100.16	116	50	1050	950		950	
Methyl n-amyl ketone	114.19	152	50	1250	1000		1000	
Methyl propyl ether	74.12	39		200	150		150	
Methyl propyl ketone	86.13	102	200	*	*		*	
Naphtha, coal tar		110-190	100	1400	1200		1200	
Naphthalene	128.16	218	10	1500	1300		1300	
Nitrobenzene	123.11	210	1	380	270		300	
Nitroethane	75.07	114	100	750	540		600	
Nitromethane	61.04	101.2	100	650	460		650	
1-Nitropropane	89.09	130	25	1000	900		900	
2-Nitropropane	89.09	120	10	650	500		500	
Nitrotoluene (all isomers)	137.13	222-238	2	1300	1100		1100	
n-Nonane	128.26	151	200	1200	950		950	
i-Octane	114.22	99.2		1120	800		940	
n-Octane	114.22	125.6	300	900	640		750	
Oleic acid	282.45	Decomp		*				

Chemical name	Relative Molecular Mass	Boiling Point/ °C	TLV /ppm	OS Filter /g	H+ Filter /g	F Filter /g	MP Filter /g	Safety Notes
Paraffin wax fume				*				
Parathion	291.27	375		*				
n-Pentane	72.15	36.1	600	650	460		550	
Pentachloroethane	202.31	162		2400	*		*	
1-Pentanol	88.15	138		1150	*		*	
2-Pentanol	88.15	119		1000	*		*	
3-Pentanol	88.15	116		850	*		*	
Petroleum ether, 60 °C – 80 °C	-	60 - 80	500	1050	750		790	
Petroleum spirit 100 – 120 °C	-	100-120	500	1100	760		800	
Phenol	94.11	182	5	400	250		250	
Phenyl ether	170.20	259	1	*	*		*	
Phenylglyceryl ether	151.16	129-142		*	*		*	
Phthalic anhydride	148.11	295	1	*	*		*	
Picric acid	229.11	300			*			Explodes at Bpt.
Piperidine	85.15	106		*				
Pine oil		200-220		*				
Propan-2-ol	60.09	82.4	400	1480	1050		1100	
n-Propyl acetate	102.13	102	200	1350	1000			
n-Propyl alcohol	60.09	97	200	700	580		550	
n-Propylamine	59.11	49		250				
Propylene dibromide	201.91	119		1400				
Propylene dichloride	112.99	95	75	1200				
Propylene oxide	58.08	34	20	180				
Pyridine	79.10	115.5	5	750	530		600	
Resorcinol	110.11	280	10	*				
Solvent naphtha (s.g. 0.86)			500	1300	930		660	
Stoddard solvent (White spirits)		220-300	100	1200				
Styrene (vinyl benzene)	104.14	145	50	1250	890		1000	
1,1,2,2-tetrachloro ethane (acetylene tetrachloride)	167.86	147	1	1850	1300		1450	Restrict to 1000 g max due to high toxicity
Tetrachloro ethylene	165.83	121	50	1820	1320		1430	
Tetrahydrofuran	72.12	65	200	950	715		750	
Toluene	92.13	110.6	50	1280	910		980	
1,1,1-Trichloroethane	133.42	74.1	350	1700	1200			
Trichloroethylene	131.40	86.7	50	1800	1250		1400	
1,2,3-Trichloro propane	147.43	157	10	2050	1450		1600	
Triethylamine	101.19	90	10	*				
Triethylene tetramine	146.23	266		*				
Trimethyl benzene	120.1	176		1350				
Trinitrotoluene	227.13				*			Explodes at Boiling point
Vinyl acetate	86.09	73	10	750	540		600	
Vinyl butyl ether	100.12	94		800	700		680	
Vinyl chloride	62.50	-14	5	950				
Vinylidene chloride	96.95	32	5	*				
Vinyl toluene (2-methyl styrene)	118.18	171	50	1320	920		1040	
Xylidine	121.18	213-216	2	*				
Xylene	106.16	137-144	100	1360	970		1060	

Guideline Retention Capacities of Chemcap Filters at 50 % of TLV or VME or MAK:

INORGANIC CHEMICALS

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV /ppm	OS Filter /g	H+ Filter /g	F Filter /g	MP Filter /g	Safety Notes
Ammonia	17.03	-33.4	25			350	120	
Boron trichloride	117.19	12.5			*			
Chlorine	35.45	-35	0.5		500			
Hydrochloric acid (35 %)	36.5	-	5	1000	1500		850	
Hydrogen bromide					*			
Hydrogen chloride	36.5	-85.05	5		525	-	300	
Hydrogen fluoride	20.01	19.5	3	-	480	-	-	
Hydrogen iodide					*			
Hydrogen sulphide	34.08	-60	10	-	480	-	-	
Nitric acid (68 %)	63	120	2	1300	1550	-	970	
Nitrogen dioxide					*			
Sulphuric acid	98.08	290		980	1540		880	

FUMES AND PARTICULATE SPECIES REQUIRING ADDITIONAL HEPA FILTRATION

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV/ Mg m^{-3}	OS Filter /g	H+ Filter /g	MP Filter /g	**HEPA** Filter /g	Safety Notes
Acrylamide	71.08	BP 141	0.03	*			*	
Aluminium metal	26.98	MP 660 BP 2327	10				*	
Aluminium oxide	101.94	MP 2000	10				*	
Alumium	26.98		5				*	Pyrophoric and welding
Aluminium chloride	133.34	Subl. 180	2				*	
Alumium compounds			2				*	Soluble salts and alkali
Ammonium bicarbonate	79.06	Decomp. 60					*	
Ammonium bifluoride	57.05	MP 125					*	
Ammonium bromide	97.96	Subl.					*	
Ammonium chloride	53.50	Subl.	10				*	
Ammonium peroxydisulphate	228.20	Decomp.					*	
Ammonium sulphamate	114.13	MP 131	10				*	
Antimony	121.75	MP 630 BP 1635	0.5				*	
Antimony compounds			0.5				*	As Sb
Antimony trioxide	291.52	MP 655 BP 1425	0.5				*	As Sb
Arsenic	74.92	Subl. 100	0.5				*	
Arsenic compounds			0.5				*	
Asbestos			0.2				*	Fibres
Aspaltic fumes			5				*	
Barium	137.33	MP 710 BP 1600	0.5				*	
Barium, soluble compounds			0.5				*	As Ba
Benzoic acid	122.12	Subl. 100					*	
Benzoyl peroxide	242.22	MP 100	5	*			*	May explode When heated
Beryllium	9.01	MP 1287 BP 2500	0.002				*	
Beryllium compounds							*	
Bismuth telluride	800.83		10				*	
Bismuth telluride (Se doped)			5				*	
Boron	10.81	MP 2200					*	
Boric acid	61.84	MP 171					*	
Boron oxide	69.62	MP 450	10				*	
Boron tribromide	250.57	MP -46 BP 91	10				*	
Boron trifluoride	67.82	MP -127 BP -100	3				*	
Cadmium	112.41	MP 321 BP 765	0.05				*	
Cadmium salts			0.05				*	As Cd
Cadmium oxide	128.41	MP >1500	0.05				*	
Caesium hydroxide	150.1	MP 272	2				*	
Calcium carbonate (marble)	100.09	Varies					*	
Calcium arsenate	396.04		1				*	

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV/ Mg m^{-3}	OS Filter /g	H+ Filter /g	MP Filter /g	**HEPA Filter /g**	Safety Notes
Calcium cyanamide	80.11	MP 1340 Subl. 1180	0.5				*	
Calcium hydroxide	74.10	Decomp.	5				*	
Calcium oxide	56.08	MP 2572 BP 2850	2				*	
Calcium silicate							*	
Calcium sulphate	136.14		10				*	
Caprolactam dust	113.16		1				*	
Caprolactam vapour	113.16		20		*		*	
Carbaryl	201.22	MP 142	5				*	
Carbon black			3.5				*	
Catechol	110.11	MP 105 BP 245	20				*	
Chromium metal	52.00	MP 1900 BP 2642	0.5				*	Dust
Chromates, insoluble forms			0.05				*	
Chromates, soluble forms			0.05				*	
Chromium trioxide	100.01	MP 197 Decomp. 250	0.05				*	
Clopidol	192.06	MP 320	10				*	
Coal tar pitch volatiles			0.2	*			*	
Cobalt, metal, dust and fume	58.93	MP 1493 BP 3100	0.05				*	As Co
Copper fume	63.55	MP 1083 BP 2595	0.2				*	As Cu
Copper dusts and mists			1				*	As Cu
Ferbam	416.50	Decomp. 180	10		*		*	
Ferrovanadium dust			1				*	
Fluorides			2.5				*	As F
Graphite, natural			2.5				*	
Graphite, synthetic			10				*	
Hafnium	178.49	MP 2227	0.5				*	
Hydroquinone	326.40	MP 171 BP 286	2				*	
Indium and compounds			0.1				*	
Iron oxide fume	159.69	MP 1565	5				*	As Fe
Iron salts, soluble			1				*	As Fe
Iron dicyclopentadienyl	186.03	MP 173	10				*	
Lead, inorganic fume and dust			0.15				*	
Lead arsenate			0.15				*	As Pb
Lead chromate		MP 844	0.05				*	As Cr
Lead sulphide	239.28	MP 1114	0.15				*	
Lithium hydride	7.95	MP 471	0.025				*	
Magnesium oxide fume	40.32	MP 2800	10				*	As Mg
Manganese metal and compounds			5				*	As Mn
Manganese fume			1				*	As Mn
Manganese tetroxide	228.81	MP 1564	1				*	

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV/ Mg m^{-3}	OS Filter /g	H+ Filter /g	MP Filter /g	**HEPA** Filter **/g**	Safety Notes
Mica			3				*	
Molybdenum, insoluble compounds			10				*	As Mo
Molybdenum, soluble compounds			5				*	As Mo
Nickel soluble compounds			0.1				*	As Ni
Nickel sulphide roasting fume and dust	240.10	MP 790	1				*	As Ni
							*	
Paraffin wax fume			2	*			*	
Paraquat chloride (Gramoxone)	240.20	MP 300 Decomp.	0.1				*	
Phosphorus, yellow	123.89	MP 44 BP 280	0.1				*	
Platinum	195.08	MP 1774 BP 3827	1				*	
Platinum, soluble salts			0.002				*	As Pt
Portland cement			10				*	
Potassium hydroxide	56.10	MP 360	2				*	
Potassium persulphate	270.32	Decomp. 100	5				*	
Rhodium, metal fume and dust	102.91	MP 1966	0.1				*	As Rh
Rhodium, insoluble salts			1				*	As Rh
Rhodium, soluble salts			0.001				*	As Rh
							*	
Selenium compounds			0.2				*	As Se
Selenium hexafluoride	192.96	Subl. – 63.8	0.2				*	Not recommended
Silicon, dust	28.09	MP 1410	10				*	
Silicon carbide, dust	40.07		10				*	
Silver, insoluble compounds			0.1				*	
Silver metal, and soluble compounds			0.01				*	As Ag
Sodium bisulphite	104.07		5				*	
Sodium fluoroacetate	100.01	MP 200	0.05				*	
Sodium hydroxide	40.01	MP 318 BP 1390	2				*	
Sodium metabisulphite	190.13		5				*	
Sodium persulphate	238.13		5				*	
Sodium tetraborate Anhydrous	201.27	MP 741	1				*	
Sodium tetraborate pentahydrate			1				*	
Sodium tetraborate Decahydrate			5				*	
Tantalum	180.95	MP 2996 BP 5429	5				*	
Tantallum oxide, dust			5				*	
Tellurium and compounds			0.1				*	As Te
Thallium, soluble compounds			0.1				*	As Ti
Tin, inorganic compounds, except SnH_4 and SnO_2			2				*	As Sn
Tin, organic compounds			0.1				*	As Sn
Titanium dioxide	79.90	MP 1855	10				*	

Chemical name	Relative Molecular Mass	Boiling Point / °C	TLV/ Mg m^{-3}	OS Filter /g	H+ Filter /g	MP Filter /g	**HEPA Filter /g**	Safety Notes
Tungsten	183.85	MP 3410 BP 5900	5				*	
Tungsten, insoluble compounds			5				*	As W
Tungsten, soluble compounds			1				*	As W
Uranium, natural, soluble and insoluble compounds			0.2				*	As U
Vanadium pentoxide, dust	181.90	MP 690	0.5				*	As V
Vanadium pentoxide, fume	181.90		0.05				*	As V
Yttrium and compounds			1				*	
Zinc chloride, fume	136.29	MP 290 BP 732	1				*	
Zinc chromate	233.37		0.01				*	As Cr
Zinc oxide, dust	81.38		10				*	
Zinc oxide, fume	81.38		5				*	