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# 3M Respirator Selection Guide



## **For more information**

### **In U.S.**

Technical Assistance 1-800-243-4630

Customer Care Center 1-800-328-1667

[3M.com/PPESafety](https://www.3M.com/PPESafety)

### **In Canada**

Technical Assistance 1-800-267-4414

Customer Care 1-800-364-3577

[3M.ca/PPESafety](https://www.3M.ca/PPESafety)

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## WARNING

### Respirator Capabilities and Limitations

- Selection of appropriate respiratory protective equipment (RPE) will depend on each situation and should be made only by a competent person knowledgeable of the actual working conditions and the limitations of RPE.
- Refer to applicable government regulations regarding respirator selection, which take precedence over a respirator manufacturer's guidance. In the U.S., please see [www.osha.gov](http://www.osha.gov) or <https://multimedia.3m.com/mws/media/2191610/3m-regulations-handbook-respiratory-protection.pdf> for more information.
- Respirators help protect against certain airborne contaminants, but no respirator is capable of preventing all airborne contaminants from entering the wearer's breathing zone.
- Hazardous airborne contaminants in the workplace must be identified and quantified. Many contaminants that can be dangerous to a person's health cannot be seen or smelled at dangerous levels.
- Do not use respirators when airborne contaminant concentrations exceed maximum use concentrations established by regulatory agencies.
- Only use self-contained breathing apparatus (SCBA) or combination supplied air/SCBA when concentrations are unknown, or in atmospheres containing less than 19.5% oxygen. Air purifying respirators do not supply oxygen.
- Before use, the wearer must read and understand the respirator *User Instructions*. **Failure to follow all instructions and limitations on the use of these respirators and/or failure to wear them properly during all times of exposure can reduce respirator effectiveness and may result in sickness or death.**
- Before use of any respirator, the wearer must first be trained by their employer in proper respirator use in accordance with applicable safety and health standards.
- In the U.S., a written respiratory protection program must be implemented meeting all the requirements of OSHA 29 CFR 1910.134 including training, fit testing, and medical evaluation. In Canada, CSA standard Z94.4 requirements must be met and/or requirements of the applicable jurisdiction, as appropriate.

- Leave the contaminated area immediately if dizziness or other distress occurs, if the respirator becomes damaged or breathing becomes difficult, if contaminants can be smelled or tasted, or if irritation occurs.
- Do not use tight-fitting respirators or loose-fitting facepieces with beards or other facial hair or conditions that prevent direct contact between the face and the edge of the respirator.
- Maintenance, cleaning, and storage programs must be established and routinely followed for respirators that are reused.
- For correct use, consult supervisor and *User Instructions*, or call 3M Personal Safety Division (PSD) Technical Service in the U.S.A. at 1-800-243-4630. In Canada, call 1-800-267-4414.

### How to Use This Guide

Respirators are normally selected based upon workplace contaminants, concentrations, application specific requirements and human factors.

### Contaminants

1. Identify the air contaminants present in the workplace and list them on the form contained in this guide or on your own form. If contaminants are unknown, or in atmospheres containing less than 19.5% oxygen, use only self-contained breathing apparatus (SCBA) or combination supplied air/SCBA for the respirator type.

Contaminant	Filter, Cartridge or Supplied Air	IDLH	OEL	Air Concentration	Hazard Ratio	Respirator Type
Summary						

2. Look up each of your contaminants in this guide. Enter the suggested type of filters and/or cartridges or supplied air (SA) in the form. An explanation of the abbreviations is given at the end of the guide.

Note:

- If airborne oil mist is present in addition to your listed contaminants, then a R- or P-series or HEPA filter must be selected instead of a N-series filter.
- If any of the contaminants are being aerosolized (e.g. sprayed), then a particle filter must be added if not already included.
- For powered air purifying respirators (PAPRs), use a HEPA filter instead of the N, R or P type particle filters listed in the guide.

On the bottom row, list the type of filter and/or cartridge that is applicable for ALL of the contaminants together on your form. If SA is suggested for any of the contaminants, or if there is no sufficient cartridge/filter for all of the contaminants together, then SA must be used.

3. Where applicable, list contaminant air concentrations considered immediately dangerous to life or health (IDLH) on the form. IDLH values are published by the National Institute for Occupational Safety and Health (NIOSH) <https://www.cdc.gov/niosh/idlh/default.html>, but OSHA allows employers to use other IDLH values. The lower explosive level (LEL) or the concentration that would result in an oxygen deficient atmosphere should also be considered IDLH. If contaminant exposure levels are potentially at or above IDLH, use only self-contained breathing apparatus (SCBA) or combination supplied air/SCBA for the respirator type.

4. Enter the occupational exposure limits (OELs) on the form. References for OELs include [www.OSHA.gov](http://www.OSHA.gov) for permissible exposure limits (PELs) or [www.acgih.org](http://www.acgih.org) for threshold limit values (TLV@s). Depending on the contaminant you may need to enter more than one type of OEL based on the duration and variability of exposure levels:

- Time Weighted Average (TWA) exposure limits are for an eight (8) hour workday and a forty (40) hour workweek.
- Short-Term Exposure Limits (STEL) are a 15-minute time weighted average exposure.
- Ceiling (C) exposure limits refer to concentrations that should not be exceeded during any part of the workday.

If you have extended work shifts, or multiple contaminants with similar health effects you may wish to adjust the OELs—see an industrial hygienist for assistance.

5. Determine contaminant air concentrations and list them on the form. Air sampling in the worker's breathing zone is highly recommended. Consideration should be given to the 8 hour time weighted average (TWA), 15 minute short term and peak (ceiling) exposures, while keeping in mind seasonal and worker variability and the specific process being used.

6. Calculate the hazard ratio (HR) as the airborne contaminant concentration / OEL. Enter the hazard ratio on the form.
7. Choose a respirator type with an assigned protection factor (APF) that is higher than the hazard ratio. Assigned protection factors\* per OSHA 29 CFR 1910.134 are as follows:

#### Air Purifying Respirators

- Half facepiece (filtering facepiece-disposable and reusable): 10
- Full facepiece (with quantitative fit testing): 50

#### Powered Air Purifying Respirators

- Loose-fitting facepiece: 25
- Half facepiece: 50
- Full facepiece, helmet, or hood: 1000\*\*

#### Supplied Air Respirators (airline)

- Continuous Flow
  - Loose-fitting facepiece: 25

- Half facepiece: 50
- Full facepiece, helmet, or hood: 1000\*\*

- Pressure demand with full facepiece: 1000

#### Self-Contained Breathing Apparatus (SCBA)

- Pressure demand airline with escape SCBA: 10,000 unknown and IDLH atmospheres
- Pressure demand SCBA: 10,000 unknown and IDLH atmospheres

\*Assigned protection factors may vary based on specific standards such as those promulgated by U.S. OSHA. Where assigned protection factors in local, state, or federal standards are lower than those listed here, they should be used instead. For additional limitations of 3M respiratory protection products, refer to 3M respirator packaging and *User Instructions*.

\*\* Respirator manufacturer must provide

data demonstrating performance of 1000 or greater, otherwise APF of 25.

### Other Considerations

- If a gas/vapor cartridge is selected, a change schedule must be implemented, otherwise supplied air respirators must be used instead.
- If any of the respirator codes contain the (F) designation, respirators with half facepieces cannot be used unless appropriate eye protection is also worn.
- If a chemical can be absorbed through the skin, skin protection may be required in addition to respiratory protection. Eye protection may also be necessary if not provided by the respirator. Failure to provide adequate skin or eye protection can invalidate established exposure limits and make respirator use ineffective for

protection against certain workplace contaminants.

### **Application Specific Requirements and Human Factors**

Consider the entire package of safety equipment required for the job. The respirator selected must be compatible with hard hats, goggles, glasses, welding hoods, face shields, etc. In addition, the worker must be able to communicate and perform required job duties without removing the respirator. If strenuous work is to be performed, or if the respirator is to be worn for an extended period of time, it may be desirable to select a lightweight respirator with low breathing resistance. If a respirator does not have good worker acceptance or is not worn consistently, it will not provide the expected protection.

When specifying supplied air respirators, consider the distance the worker must travel to get to an uncontaminated work area,

as well as obstacles or equipment present in the area. If ladders or scaffolds must be climbed, a supplied air respirator with air line may not be appropriate.

### **Questions?**

For assistance, call 3M Personal Safety Division (PSD) Technical Service in the U.S.A. at 1-800-243-4630. In Canada, call 1-800-267-4414.

### **Selection Guide Format Explanation Contaminant**

Contaminant names listed in this guide are generally those used in the Threshold Limit Values and Biological Exposure Indices published by the American Conference of Governmental Industrial Hygienists (ACGIH). Pesticides and chemicals without established occupational exposure limits are not included. Call 3M Technical Service for assistance in selecting respirators for

these chemicals.

### **CAS#**

Chemical abstract service registry numbers were established by the American Chemical Society to harmonize chemical identification regardless of the synonym used or differences in spelling.

### **Synonyms**

Several common synonyms are listed in this column.

### **Respirator Type**

This column lists the suggested type of particulate, gas/vapor, or supplied air respirator. The abbreviations used are explained at the end of this document.

Not all of these respirators have been specifically tested against each compound listed. Either specific testing or a review of chemical and physical properties of the materials, as well as adsorption or filtration



characteristics of the respirators, forms the basis for the recommendations.

The recommendations are for single substances. When two or more substances are present, a combination respirator may be appropriate. For example, with a spray paint that contains organic solvents and titanium dioxide, a respirator consisting of an organic vapor cartridge and a particle filter may be appropriate. In cases where an air purifying respirator is not available for all of the substances of concern in a mixture, a supplied air respirator may be required.

In some cases, the respirator is preceded by an “(F)” designation. These contaminants have been identified as potential eye irritants. Full facepieces, hoods, helmets or loose fitting facepieces, or half facepieces with

appropriate eye protection should be considered.

### **Particulate Filter Definitions**

N-Series filters may be used for solid or liquid airborne particulates that do not contain oil.

R-Series filters may be used for solid or liquid airborne particulates including oil-based aerosols. If the atmosphere contains oil, R-series filters are limited to 8 hours of continuous or intermittent use.

P-Series filters may be used for solid or liquid airborne particulates including oil-based aerosols. NIOSH requires that respirator manufacturers establish time-use limitations for all P-series filters. 3M recommends that in atmospheres containing oil aerosols, P-series filters are limited to 40 hours of use or 30 days, whichever occurs first.

Note: All particle filters must also be replaced subject to conditions of hygiene, damage or

increased breathing resistance/reduced air flow.

Oils are mineral, vegetable and synthetic substances and animal and vegetable fats that are generally slippery, combustible, viscous, liquid or liquefiable at room temperatures soluble in various organic solvents such as ether but not in water.

95 level filter is > 95% filtration efficiency per the NIOSH 42 CFR 84 test method.

100 level filter is > 99.97% filtration efficiency per the NIOSH 42 CFR 84 test method.

HEPA Filter is > 99.97% filtration efficiency per the NIOSH 42 CFR 84 test method for powered air purifying respirators (PAPRs) only. Use instead of N, R, P type filters.

## Comments

Other information may be listed in this column:

- A. Short service life means predicted cartridge life of less than 30 minutes at concentrations such as 10 times the OEL, or the contaminant's boiling point is less than 65°C. Actual service life will vary considerably depending on concentration levels, temperature, humidity, work rate, etc. See 3M Service Life Software [www.3M.com/sls](http://www.3M.com/sls) to estimate cartridge service life. Sometimes a supplied air respirator is recommended because the service life may be so short that the frequency required for changing the cartridges is not practical.
- B. References to a respirator not being specifically approved refer to a lack of approval for a particular substance. All respirators listed in this guide are NIOSH approved for certain substances and/or conditions.
- C. References to Ineffective sorbents or Unknown sorbent effectiveness indicate 3M does not make chemical cartridge respirators appropriate for these substances at this time or it is not known how effective the sorbents would be for these materials.
- D. These compounds have been identified as possibly existing in both particulate and vapor phase in the workplace. For these compounds, 3M recommends that a gas/vapor cartridge be used in addition to the traditionally accepted particulate filter. It is the user's responsibility to determine whether both forms coexist. Both chemical properties and use conditions/processes can affect the physical form in the workplace. Users should consider specific exposure data and workplace conditions before making their final selection.\* If a chemical cartridge is used, a change schedule must be established to replace the cartridges before the end of their service life.
- E. These compounds have been identified as possibly existing in both vapor and particulate phase in the workplace. Even though these chemicals would be expected to be in the vapor phase, when other aerosols are present or there is high humidity, it is possible that the vapor may be adsorbed onto these coexisting particles or dissolved in available water droplets; therefore, 3M recommends a filter for the particulate phase be used in addition to the traditionally accepted chemical cartridge. It is the user's responsibility to determine whether both forms coexist. Both chemical properties and use conditions/processes can affect the physical form in the workplace. Users should consider specific exposure data and workplace conditions before making their final selection.\*

- F. It is believed that an N-series filter is sufficient since these materials will not coat the filter fibers, but since this material may contain oil aerosols, an R- or P-series filter is recommended until further research or a regulatory agency takes a specific position.
- G. R- or P-series filters have been recommended pending more research as to how these materials affect the filter fibers.
- H. 3M™ Personal Air Monitors may be used to measure the amount of specific organic vapors, aldehydes or ethylene oxide in the air. 3M Monitors may be purchased with or without pre-paid analysis. Please see [www.3M.com/badgemonitors](http://www.3M.com/badgemonitors) for more information.
- I. Skin notations indicate the substance can be absorbed through the skin. In these cases, appropriate measures must be taken to prevent skin and eye contact to avoid invalidating the OEL.

\* See Perez, C. and S. C. Soderholm: Some Chemicals Requiring Special Consideration When Deciding Whether to Sample the Particle, Vapor, or Both Phases of an Atmosphere. *Appl. Occup. Hyg.* 6(10): 859-864 (1991).

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Acetaldehyde	75-07-0	Acetic aldehyde, Ethanal		(F)OV (F)MG	Short OV service life. Multigas cartridge recommended for longer service life. 3M Formaldehyde Monitors.
Acetamide	60-35-5	Ethanamide		OV/N95	See comment D in Introduction
Acetic acid	64-19-7	Ethanoic acid, Glacial acetic acid, Methane carboxylic acid, Vinegar acid		(F)OV/AG	
Acetic anhydride	108-24-7	Acetic acid anhydride, Acetyl oxide, Ethanoic anhydride		(F)OV	
Acetone	67-64-1	2-Propanone, Dimethyl ketone, Ketone propane		OV	Short service life. 3M Organic Vapor Monitors.
Acetone cyanohydrin	75-86-5	2-Cyano-2-propanol, 2-Hydroxy-2-methyl propanenitrile, 2-Methylactonile, 2-Propane cyanohydrin, a-Hydroxy isobutyronitrile	Y	OV	
Acetonitrile	75-05-8	Cyanomethane, Ethane nitrile, Ethyl nitrile, Methanecarbonitrile, Methyl cyanide	Y	OV	3M Organic Vapor Monitors

NOTE: See important warnings, definitions, and explanation of column headings and abbreviations starting on page 1. For occupational exposure limits, please see your local regulatory authority. In the US, please see <https://www.osha.gov/annotated-pels>.

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Acetophenone	98-86-2	1-Phenylethanone, Acetyl benzene, Benzoyl methide, Methyl phenyl ketone		OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Acetylsalicylic acid	50-78-2	Aspirin		N95	
Acrolein	107-02-8	Acrylaldehyde, Acrylic aldehyde, Allylaldehyde, Propenal	Y	(F)OV	Short service life
Acrylamide	79-06-1	Acrylamide monomer, Acrylic amide, Propenamamide	Y	OV/N95	See comment D in Introduction
Acrylic acid	79-10-7	Acroleic acid, Propenoic acid	Y	(F)OV	
Acrylonitrile	107-13-1	AN, Propenenitrile, Vinyl cyanide	Y	OV	SA if cartridge not disposed of after shift, per 29 CFR 1910.1045. 3M Organic Vapor Monitors.
Adipic acid	124-04-9	1,4-Butanedicarboxylic acid, 1,6-Hexanedioic acid, Adipinic acid, Hexanedioic acid		(F)N95	
Adiponitrile	111-69-3	1,4-Dicyanobutane, Addipic acid dinitrile, Hexanedinitrile, Tetramethylene cyanide	Y	OV	
Allyl alcohol	107-18-6	2-Propen-1-ol, 2-Propenol, Vinyl carbinol	Y	(F)OV	3M Organic Vapor Monitors

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Allyl bromide	106-95-6	1-Bromo-2-propene; 1-Propene, 3-bromo-; 2-Propenyl bromide; 3-Bromo-1-propene; 3-Bromopropene; 3-Bromoproylene	Y	(F)OV	
Allyl chloride	107-05-1	1-Chloro-2-propene, 3-Chloropropene	Y	OV	Short service life. 3M Organic Vapor Monitors.
Allyl glycidyl ether	106-92-3	1-Allyloxy-2,3-epoxy-propane, AGE		(F)OV	
Allyl isothiocyanate	57-06-7	AITC, Allyl isosulfocyanate, Allyl thiocarbamide, 3-Isothiocyanate-1-propene, Oil of mustard	Y	OV	SA if used with acids
Allyl methacrylate	96-05-9	AMA	Y	OV	
Allyl propyl disulfide	2179-59-1	2-Propenyl propyl disulfide, Onion oil, Propyl allyl disulfide		(F)OV	
alpha-Alumina	1344-28-1			N95	
Aluminum metal and insoluble compounds	7429-90-5			N95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
p-Aminobenzoic acid	150-13-0	4-Aminobenzoic acid, Aminobenzoic acid, PABA		(F)N95	
2-Aminopyridine	504-29-0	a-Aminopyridine		OV	
Aminotri (methylenephosphonic acid)	6419-19-8	ATMP, Briquest 301-32S, Briquest 302-500, Dequest 2000, Dequest 2001, Nitriлотrimethanephosphonic acid, NTF, NTMP, NTPA		AG/N95	If heated, AG cartridge may be needed
Ammonia	7664-41-7	Anhydrous ammonia		(F)AM	Irritation also provides warning
Ammonium chloride (liquids)	12125-02-9			AM/N95	
Ammonium chloride (solids)	12125-02-9			N95	
Ammonium perfluorooctanoate	3825-26-1		Y	OV/N95	See comment D in Introduction
n-Amyl alcohol	71-41-0	1-Pentanol, Amyl alcohol, n-Butyl carbinol, n-Pentanol, Pentanol, Pentyl alcohol		(F)OV	
tert-Amyl methyl ether	994-05-8	TAME		OV	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Aniline	62-53-3	Aminobenzene, Aniline oil, Phenylamine	Y	OV	
o-Anisidine	90-04-0 29191-52-4	2-Methoxyaniline, o-Aminoanisole, o-Methoxyaniline (oil)	Y	OV/P95	
p-Anisidine	104-94-9 29191-52-4	4-Methoxyaniline, p-Aminoanisole, p-Methoxyaniline (solid)	Y	OV/N95	
Antimony and compounds (as Sb)	7440-36-0			N95	
Arsenic, elemental	7440-38-2			N100	
Arsenic, inorganic compounds (except arsine) (as As)				MG/N100	No half mask respirators for arsenic trichloride because of skin adsorption. N100 may be appropriate if vapor concentrations are below exposure limits
Arsenic, organic compounds (as As)		Arsenic, organic compounds (as As)		OV/N100	MG/N100 may be required for certain organic arsenic compounds



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Arsine	7784-42-1	Arsenic hydride, Arsenic trihydride, Arseniuretted hydrogen, Arsenous hydride, Hydrogen arsenide		(F)SA	Unknown sorbent effectiveness
Asbestos	1332-21-4	Actinolite, Amosite, Anthophyllite, Chrysotile, Crocidolite, Tremolite		N100	Dual cartridge as per 29 CFR 1910.1001, 1915.1001 and 1926.1101
Asphalt (petroleum; bitumen) fumes	8052-42-4	Asphaltic bitumen, Asphaltum, Bitumen, Hot mix asphalt, Mineral pitch, Petroleum asphalt, Road asphalt, Road tar		OV/P95	R or P95 alone may be suitable for some applications. See comment F in Introduction
Barium and soluble compounds (as Ba)	7440-39-3			N95	
Barium sulfate	7727-43-7			N95	
Benzaldehyde	100-52-7	Benzenecarbonal, Benzoic aldehyde, Oil of bitter almond		(F)OV	3M Formaldehyde Monitors
Benzene	71-43-2	Benzol, Coal tar naptha	Y	OV	SA if cartridges are not replaced at the start of each shift, per 20 CFR 1910.1028. 3M Organic Vapor Monitors.

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Benzophenone	119-61-9	Benzoyl benzene, Diphenyl ketone, Diphenyl methanone, Phenyl ketone		OV/N95	See comment D in Introduction
Benzotrichloride	98-07-7	Benzenyl trichloride, Benzenylchloride, Benzoic trichloride, Benzyl trichloride, Phenyl chloroform, Toluene trichloride, Trichloromethylbenzene	Y	(F)OV	
Benzoyl chloride	98-88-4	a-Chlorobenzaldehyde, Benzene carbonyl chloride, Benzoic acid chloride		"(F)OV/AG (F)MG"	
Benzoyl peroxide	94-36-0	Dibenzoyl peroxide		OV/N95	See comment D in Introduction
Benzyl acetate	140-11-4	Acetic acid benzyl ester, Acetic acid phenylmethyl ester, Phenylmethyl acetate		OV/N95	
Benzyl alcohol	100-51-6	a-Hydroxytoluene, Phenylcarbinol, Phenylmethanol		(F)OV	3M Organic Vapor Monitors
Benzyl chloride	100-44-7	a-Chlorotoluene		(F)OV/AG	See comment E in Introduction. 3M Organic Vapor Monitors.

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Beryllium and compounds (as Be)	7440-41-7		Y	N95	See OSHA standard 1910.1024 regarding PAPRs requested by employee
Biphenyl	92-52-4	Diphenyl, Phenylbenzene		OV/N95	
Bismuth telluride (undoped)	1304-82-1	Bismuth sesquitelluride		N95	
Bismuth telluride (Se-doped) (as Bi <sub>2</sub> Te <sub>3</sub> )				N95	
Boric acid	10043-35-3	Borofax, Boron trihydroxide, Hydrogen orthoborate, Kill-off, Kjel-sorb, Orthoboric acid, Three elephant, Trihydroxyborane		N95	
Boron oxide	1303-86-2	Anhydrous boric acid, Boric anhydride, Boric oxide		N95	
Boron tribromide	10294-33-4	Boron bromide		(F)AG	
Boron trichloride	10294-34-5	Trichloroboron		(F)AG	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Boron trifluoride	7637-07-2			(F)AG	
Boron trifluoride diethyl ether	109-63-7			(F)OV/AG	
Boron trifluoride dimethyl ether	353-42-4			(F)OV/AG	
Bromine	7726-95-6			(F)AG	Irritation also provides warning
Bromine pentafluoride	7789-30-2			AG	
Bromoform	75-25-2	Tribromomethane		(F)OV	
1-Bromopropane	106-94-5	n-Propylbromide, Propylbromide,		OV	3M Organic Vapor Monitors
1,3-Butadiene	106-99-0	Biethylene, Divinyl, Erythrene		OV	Cartridges must be replaced per 29 CFR 1910.1051. 3M Organic Vapor Monitors.

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Butane	106-97-8	n-Butane, Methyl ethyl methane		SA	Short OV service life
1-Butene	106-98-9	1-Butylene, a-Butene, a-Butylene, But-1-ene, Ethylethylene		OV	Short service life
2-Butene (mixture of trans- and cis-)	107-01-7	b-Butene, b-Butylene, Dimethylethylene, Pseudobutylene		OV	Short service life
cis-2-Butene	590-18-1	b-cis-Butylene, cis-1,2-Dimethylethylene, cis-Butene, cis-Butene-2		OV	Short service life
trans-2-Butene	624-64-6	2-Butene, (E)-, 2-trans-Butene, b-trans-Butylene, trans-1,2-Dimethylethylene, trans-Butene		OV	Short service life
2-Butoxyethanol	111-76-2	Butyl Cellosolve®, Ethylene glycol monobutylether		(F)OV	See comment E in Introduction. 3M Organic Vapor Monitors.
2-Butoxyethyl acetate	112-07-2	Acetic acid, 2-butoxyethyl ester; 2-Butoxyethanol acetate; Butyl Cellosolve™ acetate; Butylglycol acetate; EGBA; Ektasolve EB acetate; Ethylene glycol monobutyl ether acetate; Glycol monobutyl ether acetate		OV	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
n-Butyl acetate	123-86-4	Acetic acid butyl ester, Butyl acetate, Butyl ethanoate		(F)OV	See comment E in Introduction. 3M Organic Vapor Monitors.
sec-Butyl acetate	105-46-4	1-Methylpropylacetate		(F)OV	See comment E in Introduction
tert-Butyl acetate	540-88-5	Acetic acid tert-butyl ester		(F)OV	3M Organic Vapor Monitors
Butyl acrylate	141-32-2	2-Propenoic acid butyl ester, Butyl 2-propenoate		OV	3M Organic Vapor Monitors
n-Butyl alcohol	71-36-3	1-Butanol, n-Butanol, Butyl alcohol, Butyl hydroxide, Butyric alcohol, 1-Hydroxybutane, Methylolpropane, n-Propyl carbinol, Propyl methanol		(F)OV	3M Organic Vapor Monitors
sec-Butyl alcohol	78-92-2	2-Butanol, Methyl ethyl carbinol		(F)OV	3M Organic Vapor Monitors
tert-Butyl alcohol	75-65-0	2-Methyl-2-propanol, TBA, Trimethyl carbinol		(F)OV	3M Organic Vapor Monitors
Butylamine	109-73-9	1-Aminobutane, n-Butylamine	Y	AM	AM not specifically approved, but 3M recommended for longer service life

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Butylated hydroxytoluene	128-37-0	2,6-bis(1,1-Dimethylethyl)-4-methylphenol; 2,6-Di-tert-butyl-p-cresol; BHT; DBPD		(F)OV/N95	See comment D in Introduction
4-tert-Butylcatechol	98-29-3	4-(1,1-Dimethylethyl)-1,2-benzenediol; 4-tert-Butyl pyrocatechol; 4-tert-Butyl-1,1,2-dihydroxy benzene; p-tert-Butylcatechol	Y	(F)N95	
tert-Butyl chromate (as CrO3)	1189-85-1	Chromic acid di-tert-butyl ester	Y	N95	
Butylene oxide	106-88-7	BO; 1-Butene oxide; 1,2-Butene oxide; 1,2-Butylene oxide; Epoxy-butane; 1,2-Epoxybutane		OV	Short service life
n-Butyl glycidyl ether	2426-08-6	1,2-Epoxy-3-butoxypropane, BGE	Y	OV	3M Organic Vapor Monitors
tert-Butyl Hydroperoxide	75-91-2	1,1-Dimethylethyl hydroperoxide	Y	(F)OV	Irritation also provides warning
n-Butyl lactate	138-22-7	Lactic acid butylester		OV	Irritation also provides warning
Butyl mercaptan	109-79-5	1-Mercaptobutane, n-Butanethiol		OV	
o-sec-Butylphenol	89-72-5	2-sec-Butylphenol	Y	OV/P95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
p-tert-Butyltoluene	98-51-1	1-Methyl-4-tert-butylbenzene		OV	
Butyraldehyde	123-72-8	Butal, Butaldehyde, Butalyde, Butanal, Butanaldehyde, Butylaldehyde, Butyral butyric aldehyde		(F)Form	Formaldehyde cartridge not specifically approved, but 3M recommended for longer service life. 3M Formaldehyde Monitors.
Cadmium and compounds (as Cd)	7440-43-9	Cadmium oxide fume		N100	
Calcium arsenate (as As)	7778-44-1	Cucumber dust, Tricalcium arsenate, Tricalcium o-arsenate		N100	
Calcium carbonate	1317-65-3	Limestone, Marble		N95	
Calcium chromate	13765-19-0	Calcium chrome yellow	Y	N95	
Calcium cyanamide	156-62-7	Calcium carbimide, Lime nitrogen		N95	
Calcium fluoride (as F)	7789-75-5	Fluorite, Fluorospar		N95	
Calcium hydroxide	1305-62-0	Calcium hydrate, Caustic lime, Hydrated lime		N95	
Calcium oxide	1305-78-8	Pebble lime, Quicklime		N95	



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Calcium silicate (containing no asbestos and <1% crystalline silica)	1344-95-2	Calcium hydrosilicate, Wollastonite		N95	
Calcium sulfate	7778-18-9	Gypsum, Plaster of Paris,		N95	
Camphor	76-22-2	2-Camphonone, Gum camphor, Laurel camphor, Synthetic camphor		(F)OV/N95	3M Organic Vapor Monitors
Caprolactam	105-60-2	2-Oxohexamethylenimine, Aminocaproic lactam		OV/N95	See comment D in Introduction
Captan	133-06-2	N-(Trichloromethylthio)-4-cyclohexene- 1,2-dicarboximide		N95	
Carbon black	1333-86-4	Acetylene black, Channel black, Furnace black, Lamp black, Thermal black		N95	
Carbon dioxide	124-38-9	Carbonic acid gas, Dry ice		SA	Ineffective sorbents
Carbon disulfide	75-15-0	Carbon bisulfide, Carbon bisulfur, Carbon bisulphide, Carbon disulphide, Carbon sulfide, Dithiocarbonic anhydride, Sulphocarbonic anhydride, Weevitox	Y	OV	Short service life

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Carbon monoxide	630-08-0	Monoxide		SA	Ineffective sorbents
Carbon tetrabromide	558-13-4	Tetrabromomethane		(F)OV	
Carbon tetrachloride	56-23-5	Tetrachloromethane	Y	(F)OV	3M Organic Vapor Monitors
Carbonyl fluoride	353-50-4	Carbon oxyfluoride, Fluoroformyl fluoride		(F)MG	
Carbonyl sulfide	463-58-1	Carbon monoxide monosulfide, Carbon oxide sulfide, Carbon oxysulfide, Oxycarbon sulfide		SA	
Catechol	120-80-9	Pyrocatechol	Y	OV/N95	
Cellulose	9004-34-6	Paper fiber		N95	
Cesium fluoride (as F)	13400-13-0			N95	
Cesium hydroxide	21351-79-1	Cesuim hydrate		N95	
Chloramphenicol	56-75-7	[R-(R*,R*)]-2,2-dichloro-N-[2,hydroxy-1-(hydroxy methyl)-2-(4-nitrophenyl) ethyl] acetamide; Chloromycetin; Levomycetin		N95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Chlorinated diphenyl oxide	31242-93-0	Hexachlorodiphenyl oxide		OV/P95	
Chlorine	7782-50-5			(F)AG	Irritation also provides warning
Chlorine dioxide	10049-04-4	Chlorine oxide, Chlorine peroxide		AG	
Chlorine trifluoride	7790-91-2	Chlorine fluoride		MG	
Chloroacetaldehyde	107-20-0	2-Chloroethanal, Chloroacetaldehyde (40% aqueous)		(F)OV	
Chloroacetone	78-95-5	Chloracetone, 1-Chloro-2-propanone, Monochloroacetone	Y	(F)OV	
Chloroacetyl chloride	79-04-9	Chloroacetyl chloride	Y	(F)OV/AG	
Chlorobenzene	108-90-7	Chlorobenzol, MCB, Monochlorobenzene, Phenyl chloride		OV	3M Organic Vapor Monitors
Chlorobromo-methane	74-97-5	Bromochloromethane, CBM, Halon™ 1011, Methylene chlorobromide		OV	
1-Chloro-1,1-difluoroethane	75-68-3	a-Chloroethylidene fluoride, Chlorodifluoroethane, Dymel® 142b, Genetron™ 142b, HCFC-142b		SA	Short OV service life

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Chlorodifluoro -methane	75-45-6	Freon® 22		SA	Ineffective sorbents
Chlorodiphenyl (42% chlorine)	53469-21-9	PCB, Polychlorinated biphenyl	Y	(F)OV/P95	See comment D in Introduction
Chlorodiphenyl (54% chlorine)	11097-69-1	PCB, Polychlorinated biphenyl	Y	(F)OV/P95	See comment D in Introduction
Chloroform	67-66-3	Trichloromethane		OV	3M Organic Vapor Monitors
bis-(2-Chloroisopropyl) ether	39628-32-9	BCIPE; bis-(1-methyl-2-chloroethyl) ether; bis-2-chloro-1-methylethyl ether; Dichloroisopropyl ether		(F)OV	
bis-Chloromethyl ether	542-88-1	BCME, Chloro (chloromethoxy) methane, Chloromethyl ether, Dichloromethylether		(F)OV	OSHA requires SA with hood for certain applications; see 29 CFR 1910.1003
Chloropentafluoro -ethane	76-15-3	FC-115, Monochloropentafluoroethane		SA	Short OV service life
Chloropicrin	76-06-2	Nitrochloroform, Nitrotrichloromethane, Trichloronitromethane		(F)SA	Irritation also provides warning

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
b-Chloroprene	126-99-8	2-Chloro-1,3-butadiene; beta-Chloroprene; Chlorobutadiene	Y	(F)OV	Short service life
2-Chloropropane	75-29-6	2-CP, 2-Propyl chloride, Isoprid, Isopropyl chloride		OV	Short service life
1-Chloro-2-propanol	127-00-4	1-Chloro-2-hydroxypropane, 1-Chloroisopropyl alcohol, sec-Propylene chlorohydrin	Y	OV	
2-Chloro-1-propanol	78-89-7	1-Hydroxy-2-chloropropane, 2-Chloropropanol, 2-Chloropropyl alcohol, Propylene chlorohydrin	Y	OV	
2-Chloropropionic acid	598-78-7	a-Chloropropionic acid	Y	OV/AG	
o-Chlorostyrene	2039-87-4	1-Chloro-2-ethenylbenzene, 2-Chlorostyrene		OV	
Chlorosulfonic acid	7790-94-5	Chlorosulfuric acid, CSA		(F)AG/N95	HCl, SO <sub>2</sub> hydrolysis products
2-Chloro-1,1,1,2-tetrafluoroethane	2837-89-0	Chlorotetrafluoroethane, Fluorocarbon 124, HCFC124, HFA124		SA	Short OV service life
o-Chlorotoluene	95-49-8	2-Chloro-1-methylbenzene		OV	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Chlorotrifluoro-ethylene	79-38-9	CFE, CTFE, Trifluorochloroethylene, Trifluorovinylchloride		SA	Short OV service life
Chromium (II) compounds (as Cr)				N95	
Chromium III compounds (as Cr)				N95	
Chromium (VI) compounds (as Cr)		Chromic acid, Hexavalent chromium compounds	Y	N95	Skin notation for water-soluble compounds
Chromium metal	7440-47-3			N95	
Chromyl chloride	14977-61-8	Chloro-chromic anhydride, Chromium oxychloride	Y	(F)AG/N95	See comment E in Introduction
Citral	5392-40-5	2,6-Octadienal-3,7-dimethyl; 3,7-Dimethyl-2,6-octadienal	Y	OV/P95	See comment D in Introduction
Coal dust, Anthracite				N95	May also contain crystalline silica (quartz)

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Coal dust, Bituminous or Lignite				N95	May also contain crystalline silica (quartz)
Coal tar pitch volatiles (as Benzene solubles)	65996-93-2	Particulate polycyclic aromatic hydrocarbons, PPAH		R95 P95	Respirators with nuisance level organic vapor or acid gas relief specifically recommended
Cobalt, elemental and inorganic compounds (as Co)	7440-48-4			N95	
Cobalt carbonyl (as Co)	10210-68-1			SA	Ineffective sorbents
Cobalt hydrocarbonyl (as Co)	16842-03-8			SA	Ineffective sorbents
Coke oven emissions	65996-93-2			R95 P95	Respirators with nuisance level organic vapor or acid gas relief specifically recommended
Copper dust and mist (as Cu)	7440-50-8			N95	
Copper fume (as Cu)	7440-50-8			N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Cotton dust, raw				N95	5X PEL maximum for disposables, per OSHA cotton dust standard. If oil aerosol present, use R or P95.
Cresol (all isomers)	1319-77-3	Cresylic acid	Y	OV/P95	See comment D in Introduction. 3M Organic Vapor Monitors.
Crotonaldehyde	4170-30-3	b-Methylacrolein, Crotonic aldehyde, Propylene aldehyde		(F)OV	3M Formaldehyde Monitors
Cryolite (as F)	15096-52-3	Greenland spar, Icetone		N95	
Cumene	98-82-8	2-Phenyl propane, Cumol, Isopropyl benzene		OV	3M Organic Vapor Monitors
Cumene hydroperoxide	80-15-9	a,a'-Dimethylbenzyl hydroperoxide, CHP, Cumyl hydroperoxide, Isopropyl benzene hydroperoxide	Y	(F)OV	
Cyanamide	420-04-2	Carbodiimide, Cyanogenamide		N95	
Cyanides (as CN)			Y	SA	
Cyanogen	460-19-5	Dicyan, Oxalonitrile		MG	
Cyanogen bromide	506-68-3	Bromine cyanide		(F)SA	



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Cyanogen chloride	506-77-4	CNCl		(F)SA	Short OV service life
Cyclohexane	110-82-7	Hexahydrobenzene, Hexamethylene		(F)OV	Irritation also provides warning. 3M Organic Vapor Monitors.
Cyclohexanol	108-93-0	Anol, Cyclohexyl alcohol, Hexahydrophenol, Hexalin, Hydralin, Hydroxycyclohexane	Y	OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Cyclohexanone	108-94-1	Cyclohexyl ketone, Pimelic ketone	Y	OV	3M Organic Vapor Monitors
Cyclohexene	110-83-8	Benzene tetrahydride		OV	
Cyclohexylamine	108-91-8	Aminocyclohexane, Hexahydroaniline		(F)OV	
Cyclonite	121-82-4	Hexahydro-1,3,5-trinitro-sym-triazine; RDX; sym-Trimethylene trinitramine	Y	N95	
Cyclopentadiene	542-92-7	1,3-Cyclopentadiene		OV	Short service life
Cyclopentane	287-92-3	Pentamethylene		SA	Short OV service life
Decaborane	17702-41-9	Decaborane	Y	SA	Unknown sorbent effectiveness
Decabromodiphenyl oxide	1163-19-5	bis-(Pentabromophenyl) ether, DBDPO, Decabromodiphenyl ether		N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
1-Decene	872-05-9	a-Decene, Decylene		OV	
Dehydrolinalool	29171-20-8			OV	
Diacetone alcohol	123-42-2	2-Methyl-2-pentanol-4-one, 4-Hydroxy-4-methyl-2-pentanone, Diacetone		(F)OV	3M Organic Vapor Monitors
Diacetyl	431-03-8	Biacetyl, 2,3-Butanedione, 2,3-Diketobutane, Dimethyl diketone, Dimethylglyoxal		OV/P95	
Diallylamine	124-02-7	Di-2-propenylamine, N-2-propenyl-2-propen-1-amine	Y	OV	
Diazomethane	334-88-3	Azimethylene, Diazirine		SA	Unknown sorbent effectiveness
Diborane	19287-45-7	Boroethane		SA	Unknown sorbent effectiveness
Dibromochloro-propane	96-12-8	1,2-Dibromo-3-chloropropane; 1-Chloro-2,3-dibromopropane; DBCP		(F)SA	OSHA requires (F)SA; no change schedule allowed
Dibromoneopenytl glycol	3296-90-0	Dibromopentaerythritol		(F)R95/P95	R95/P95 acceptable with appropriate eye/face protection
Dibutylamine	111-92-2	1-Butanamine, n-butyl; Di-n-butylamine; DNBA	Y	(F)OV	See comment E in Introduction

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
2-N-Dibutylamino-ethanol	102-81-8	Dibutylaminoethanol, N,N-Dibutyl-N-(2-hydroxyethyl) amine	Y	(F)OV	
Dibutyl phenyl phosphate	2528-36-1	DBPP	Y	R95 P95	OV/P95 may be preferable if heat involved
Dibutyl phosphate	107-66-4	Dibutyl acid-o-phosphate, Dibutyl phosphoric acid, Di-n-butyl hydrogen phosphate	Y	OV/P95	See comment D in Introduction
Dibutyl phthalate	84-74-2	1,2-Benzene dicarboxylate, DBP, Dibutyl		OV/P95	See comment D in Introduction
Dichloroacetic acid	79-43-6	2-2-Dichloroacetic acid; Acetic acid, dichloro; Dichloroethanoic acid; Urmer's liquid	Y	(F)OV/AG	
Dichloroacetylene	7572-29-4	Dichloroethyne		(F)SA	Short OV service life
o-Dichlorobenzene	95-50-1	1,2-Dichlorobenzene, o-Dichlorobenzol		(F)OV	See comment E in Introduction. 3M Organic Vapor Monitors.
p-Dichlorobenzene	106-46-7	1,4-Dichlorobenzene, Dichloride, PDCB		(F)OV/N95	3M Organic Vapor Monitors

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
1,4-Dichloro-2-butene	764-41-0	2-Butylenedichloride, DCB, 1,4-DCB, Dichlorobutene	Y	(F)OV	
Dichlorodifluoro -methane	75-71-8	Freon® 12, Refrigerant 12		SA	Short OV service life
1,3-Dichloro-5,5- dimethyl hydantoin	118-52-5	Dactin, Halane		OV/N95	
1,1-Dichloroethane	75-34-3	Ethylidene chloride		OV	Short service life. 3M Organic Vapor Monitors.
1,2-Dichloro -ethylene	540-59-0 156-59-2 156-60-5	Acetylene dichloride, Dioform		OV	Short service life. 3M Organic Vapor Monitors.
Dichloroethyl ether	111-44-4	2,2'-Dichlorodiethyl ether, bis-(2-Chloroethyl) ether	Y	(F)OV	
1,1-Dichloro-1- fluoroethane	1717-00-6	Fluorocarbon 141b, HCFC 141b, HFA 141b		SA	Short OV service life
Dichlorofluoro -methane	75-43-4	Dichloromonofluoromethane, Freon® 21, Refrigerant 21		SA	Short OV service life

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
1,1-Dichloro-1-nitroethane	594-72-9			OV	
2,4-Dichlorophenol	120-83-2	2,4-DCP, DCP	Y	OV	R or P95 may also be needed if material is molten
1,3-Dichloropropene	542-75-6	1,3-Dichloropropylene	Y	(F)OV	
2,2-Dichloropropionic acid	75-99-0	Dalapon™		(F)OV/N95	
Dichlorotetrafluoro-ethane	76-14-2	FC-114, Freon® 114, Halon™ 242, Refrigerant 114		SA	Short OV service life
Dicyclopentadiene	77-73-6			OV/N95	3M Organic Vapor Monitors
Dicyclopentadienyl iron (as Fe)	102-54-5	bis-Cyclopentadienyl iron		N95	
Diesel fuel (as total hydrocarbons)	68334-30-5 68476-30-2 68476-31-3 68476-34-6 77650-28-3	Astral oil, Coal oil, Fuel oil, Gas oil, Home heating oil, Marine diesel fuel	Y	OV/P95	See comment E in Introduction

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Diethanolamine	111-42-2	Butadiene Dioxide; DEA; N,N-Diethanolamine; 2,2'-Dihydroxydiethylamine; di-(2-Hydroxyethyl)amine; Diolamine; 2,2'-Iminobisethanol	Y	OV/N95	See comment E in Introduction
Diethylamine	109-89-7		Y	(F)AM (F)OV	AM not specifically approved, but 3M recommended for longer service life
2-Diethylaminoethanol	100-37-8	2-Diethylaminoethyl alcohol, N,N-Diethylethanolamine	Y	OV	
Diethylbenzenes, mixed	25340-17-4	1,2-Diethylbenzene, 1,3-Diethylbenzene, 1,4-Diethylbenzene, DEB, Dowtherm™ J		OV	
Diethylene glycol	111-46-6	2,2'-Dihydroxydiethyl ether, DEG, Digycol		R95 P95	See comments D and G in Introduction
Diethylene glycol monobutyl ether	112-34-5	Butoxy diethylene glycol, Butoxydiglycol, Butyl Carbitol®		(F)OV/P95	See comment D in Introduction. 3M Organic Vapor Monitors.
Diethylene glycol monoethyl ether	111-90-0	2-(2-Ethoxyethoxy) ethanol, Carbitol®, DiEGEE, Diethylene glycol ethyl ether, Dioxitol, Ethyl Carbitol®, Glycol ether DE		OV	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Diethylene triamine	111-40-0		Y	(F)OV	
N,N-Diethylhydroxylamine	3710-84-7	DEHA		OV	
Diethyl ketone	96-22-0	3-Pentanone, Ethyl propionyl, Metacetone, Propione		OV	3M Organic Vapor Monitors
Diethyl phthalate	84-66-2	DEP, Ethylphthalate		R95 P95	
Difluorodibromomethane	75-61-6	DFBM, Dibromodifluoromethane, Freon® 12B2		OV	Short service life
1,1-Difluoroethane	75-37-6	Dymel® 152a, Ethylidene fluoride, Freon® 152a, Genetron™ 152a, HFC-152a		SA	Ineffective sorbents
Difluoromethane	75-10-5	Hydrofluorocarbon 32, R32, Refrigerant 32		SA	Ineffective sorbents
Diglycidyl ether	2238-07-5	2-Epoxypropyl ether, bis-(2,3-Epoxypropyl)-ether, DGE, Di-(epoxypropyl) ether, Diallyl ether dioxide		(F)OV	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Diisobutylene (mixed isomers)	25167-70-8	Diisobutene		OV	
a-Diisobutylene	107-39-1	2,4,4-Trimethyl-1-pentene, a-Diisobutene		OV	
b-Diisobutylene	107-40-4	2,4,4-Trimethyl-2-pentene, b-Diisobutene		OV	
Diisobutyl ketone	108-83-8	2,6-Dimethyl-4-heptanone, Isovalerone, sym-Diisopropylacetone, Valerone		(F)OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Diisopropylamine	108-18-9		Y	(F)OV	
Dimethyl acetamide	127-19-5	DMAC, N,N-Dimethyl acetamide	Y	OV	
Dimethylamine	124-40-3	Anhydrous dimethylamine		AM	AM not specifically approved, but 3M recommended for longer service life
bis-(2-Dimethylaminoethyl) ether	3033-62-3	DMAEE; Ethylamine, 2,2"-Oxybis (N,N- dimethyl); Niax® Catalyst A-99	Y	(F)OV	
Dimethylaniline	121-69-7	N,N-Dimethylaniline	Y	OV	3M Organic Vapor Monitors



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Dimethyl carbamoyl chloride	79-44-7	Chloroformic acid dimethylamide, Dimethyl carbamic chloride, Dimethylcarbamyl chloride, DMCC	Y	(F)MG	
Dimethyldichlorosilane	75-78-5	Dichlorodimethylsilane		OV/AG	
Dimethyl disulfide	624-92-0	2,3-Dithiabutane, Dimethyldisulfide, Dimethylsulphide, DMDS	Y	OV/AG	
Dimethyl ether	115-10-6	Methyl ether, Wood ether		SA	Short OV service life
Dimethylethoxysilane	14857-34-2	Ethoxydimethyl silane		(F)SA	Unknown sorbent effectiveness
Dimethyl formamide	68-12-2	DMF, N,N-Dimethyl formamide	Y	(F)OV	3M Organic Vapor Monitors
1,1-Dimethylhydrazine	57-14-7	UDMH, unsym-Dimethylhydrazine	Y	(F)AM	
Dimethylphenol	562-75-0, 105-67-9, 95-87-4, 576-26-1, 95-65-8, 108-68-9, 1300-71-6	2,3-Dimethylphenol, 2,4-Dimethylphenol, 2,5-Dimethylphenol, 2,6-Dimethylphenol, 3,4-Dimethylphenol, 3,5-Dimethylphenol		(F)OV/N95	See comment D in Introduction
Dimethylphthalate	131-11-3	DMP		OV/P95	See comment D in Introduction

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Dimethyl sulfide	75-18-3	DMS; Methane, thiobis; Thiobis (methane)		OV/AG	AG recommended since H <sub>2</sub> S may also be present
Dimethyl sulfoxide	67-68-5	DMSO, Methylsulfoxide		OV	3M Organic Vapor Monitors
Dimethylsulfate	77-78-1	Methyl sulfate	Y	(F)OV	
Dimethyl terephthalate	120-61-6	1,4-Benzenedicarboxylic acid, dimethyl ester; Dimethyl para-phthalate; DMT		OV/N95	
N,N-Dimethyl-para-toluidine	99-97-8	4-Dimethylaminotoluene, DMPT, N,N,4-Trimethylaniline, N,N,4-Trimethylbenzenamine		OV	
Dinitrobenzene	528-29-0 99-65-0 100-25-4 25154-54-5	1,2-Dinitrobenzene, 1,3-Dinitrobenzene, 1,4-Dinitrobenzene, m-Dinitrobenzene, o-Dinitrobenzene, p-Dinitrobenzene	Y	OV/N95	See comment D in Introduction
3,5-Dinitro-o-toluamide	148-01-6	2-Methyl-3,5-dinitrobenzamide, Coccidin, Dinitolmide, Salcostat, Zoalene		N95	
Dinitrotoluene	25321-14-6	DNT	Y	OV/N95	See comment D in Introduction

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Di-sec-octyl phthalate	117-81-7	bis(2-Ethylhexyl) phthalate, DEHP, Di-2-ethylhexyl phthalate, DOP		R95 P95	
1,3-Dioxalane	646-06-0	1,3-Dioxacyclopentane; 1,3-Dioxalan; 1,3-Dioxole, dihydroethylene glycol formal; Dioxalane; Formal glycol; Glycol methylene ether; Glycolformal		OV	3M Organic Vapor Monitors
Dioxane	123-91-1	1,4-Dioxane, Diethylene dioxide, Diethylene ether, p-Dioxane	Y	OV	3M Organic Vapor Monitors
Diphenylamine	122-39-4	DPA, N-Phenylaniline		N95	OV/N95 may be preferable when odor is a problem
Dipropylene glycol methyl ether	34590-94-8	bis(2-Methoxypropyl) ether, Dipropylene glycol monomethyl ether, Dowanol™ 50B	Y	OV	3M Organic Vapor Monitors
Dipropyl ketone	123-19-3	4-Heptanone, Butyrane		OV	
Divinyl benzene	1321-74-0	DVB, Vinylstyrene		(F)OV	
Dodecyl mercaptan	112-55-0	1-Dodecanethiol, 1-Mercaptododecane, n-Dodecyl mercaptan, n-Lauryl mercaptan		OV	R or P filter may be needed with oily aerosols

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Dowtherm™ Q		1,1-Diphenylethane with ethylated benzenes		OV/P95	
Emery	1302-74-5	Corundum		N95	
Enflurane	13838-16-9	2-Chloro-1,1,2-trifluoroethyl difluoromethyl ether, Ethrane		SA	Short OV service life
Epichlorohydrin	106-89-8	1-Chloro,2,3-epoxypropane, 2-Chloropropylene oxide, gamma-Chloropropylene oxide	Y	(F)OV	3M Organic Vapor Monitors
Erythromycin	114-07-8	Dotycin, E-Mycin, Erycynum, Erycin, Pentadecanoic acid		N95	
Ethane	74-84-0	Ethylhydride, Methyl methane			Simple asphyxiant, oxygen displacing gas
Ethanolamine	141-43-5	2-Aminoethanol, 2-Hydroxyethylamine, b-Aminoethyl alcohol, Ethylolamine, Monoethanolamine		OV	
2-Ethoxyethanol	110-80-5	Cellosolve® solvent, Ethylene glycol monoethyl ether, Glycol monoethyl ether	Y	OV	3M Organic Vapor Monitors

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
2-Ethoxyethyl acetate	111-15-9	Cellosolve® acetate, Ethylene glycol monoethyl ether acetate	Y	OV	
Ethyl acetate	141-78-6	Acetic ester, Acetic ether, Ethyl ethanoate		(F)OV	3M Organic Vapor Monitors
Ethyl acrylate	140-88-5	Acrylic acid ethyl ester	Y	(F)OV	3M Organic Vapor Monitors
Ethyl alcohol	64-17-5	Ethanol		OV	Short OV service life. 3M Organic Vapor Monitors.
Ethylamine	75-04-7	Aminoethane, Anhydrous ethylamine, Monoethylamine	Y	(F)AM	AM not specifically approved, but 3M recommended for longer service life
Ethyl amyl ketone	541-85-5	5-Methyl-3-heptanone, EAK		(F)OV	
Ethyl benzene	100-41-4	Ethylbenzol, Phenylethane		OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Ethyl benzene	100-41-4	Ethylbenzol, Phenylethane		OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Ethyl bromide	74-96-4	Bromoethane	Y	SA	Short OV service life
Ethyl butyl ketone	106-35-4	3-Heptanone		OV	See comment E in Introduction

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Ethyl chloride	75-00-3	Chloroethane, Hydrochloric ether, Monochloroethane	Y	SA	Short OV service life
Ethyl cyanoacrylate	7085-85-0	2-Cyano-2-propenoic acid, ethyl ester; 2-Cyanoacrylic acid, ethyl ester; ECA; Ethyl 2-cyano-2-propenoate; Ethyl 2-cyanoacrylate; Ethyl alpha-cyanoacrylate		(F)OV	
Ethyl tert-butyl ether	637-92-3	1,1-Dimethyl ethyl ether, 2-Ethoxy-2-methylpropane; ETBE; Ethyl 1,1-dimethylethyl ether; Ethyl tert-butyl oxide; tert-Butyl ethyl ether		OV	
Ethylene	74-85-1	Acetene, Bicarburretted hydrogen, Elayl, Ethene, Olefiant gas		(F)SA	
Ethylene chlorohydrin	107-07-3	2-Chloroethanol, 2-Chloroethyl alcohol	Y	OV	3M Organic Vapor Monitors
Ethylenediamine	107-15-3	1,2-Diaminoethane, 1,2-Ethanediamine		(F)OV	
Ethylene dibromide	106-93-4	1,2-Dibromoethane	Y	(F)OV	3M Organic Vapor Monitors
Ethylene dichloride	107-06-2	1,2-Dichloroethane, Ethylene chloride		OV	3M Organic Vapor Monitors

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Ethylene glycol	107-21-1	1,2-Ethanediol		OV/P95	See comments D and G in Introduction
Ethylene glycol dinitrate	628-96-6	Glycol dinitrate, Nitroglycol	Y	OV	
Ethyleneimine	151-56-4	Aminoethylene, Azirane, Aziridine, Dihydroazirine, Dimethylenimine, Ethyleimine	Y	(F)MG	OSHA requires SA with hood for certain applications; see 29 CFR 1910.1003
Ethylene oxide	75-21-8	1,2-Epoxyethane, Dimethylene oxide, Oxirane		(F)SA	OSHA requires (F)SA; no change schedule allowed. 3M Ethylene Oxide Monitors.
Ethyl ether	60-29-7	Diethyl ether, Ether, Ethyl oxide		OV	Short service life. 3M Organic Vapor Monitors.
Ethyl formate	109-94-4	Ethyl methanoate, Formic acid ethyl ester		(F)OV	Short service life
2-Ethylhexanoic acid	149-57-5	2-Butylbutanoic acid, Butylethylacetic acid, 2-Ethylcaproic acid, 2-Ethylhexoic acid, Ethylhexoic acid		OV/N95	See comment D in Introduction
Ethylidene norbornene	16219-75-3	ENB		(F)OV	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Ethyl isocyanate	109-90-0	Isocyanatoethene; Isocyanic acid, ethyl ester	Y	OV	Short service life
Ethyl mercaptan	75-08-1	Ethanethiol, Ethyl sulfhydrate		OV	Short service life
N-Ethylmorpholine	100-74-3	4-Ethylmorpholine	Y	(F)OV	
Ethyl silicate	78-10-4	Ethyl orthosilicate, Tetraethoxysilane, Tetraethyl silicate		OV	
Ferrovandium dust	12604-58-9			N95	
Flour dust				N95	
Fluorides (as F)		(Synonyms vary depending upon specific compound.)		N95	
Fluorine	7782-41-4			(F)SA	Unknown reaction products with sorbent
Formaldehyde	50-00-0	Formalin, Methylene oxide		(F)Form	Irritation also provides warning. 3M Formaldehyde Monitors.
Formamide	75-12-7	Methanamide	Y	OV	
Formic acid	64-18-6	Hydrogencarboxylic acid, Methanoic acid		(F)AG (F)Form	Low IDLH



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Furfural	98-01-1	2-Furaldehyde, 2-Furancarboxaldehyde, Fural, Furfuraldehyde	Y	(F)OV	
Furfuryl alcohol	98-00-0	2-Furylmethanol, 2-Hydroxymethylfuran	Y	(F)OV	See comment E in Introduction
Gallium arsenide	1303-00-0	Gallium monoarsenide		N100	
Gasoline	86290-81-5	Petrol		(F)OV	
Germanium tetrahydride	7782-65-2	Germane, Germanium hydride		(F)SA	Unknown sorbent effectiveness
Glutaraldehyde	111-30-8	1,5-Pentanedial		(F)OV	See comment E in Introduction
Glycerin mist	56-81-5	Glycerol		R95 P95	
Glycidol	556-52-5	2,3-Epoxy-1-propanol, 2-Hydroxymethyloxiran, 3-Hydroxypropylene oxide, Epoxypropyl alcohol, Hydroxymethyl ethylene oxide		OV	
Glycidyl methacrylate	106-91-2	1-Propanol, 2-3, epoxy-, ethacrylate; 2,3-Epoxypropyl methacrylate; 2-Methyl-2-propenoic acid, oxiranylmethyl ester; GMA; Methacrylic acid, 2,3-Epoxypropyl ester	Y	OV	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Glyoxal	107-22-2	1,2-Ethanedione, Biformyl, Diformyl, Ethanedial, Glyoxalaldehyde, Oxalaldehyde		(F)OV/N95	Short OV service life at 10X OEL. See comment E in Introduction
Grain dust (oat, wheat, barley)				N95	
Graphite (natural)	7782-42-5	Black lead, Corbo minerals, Plumbago, Potelot, Silver lead		N95	
Graphite (synthetic)	7440-44-0			N95	
Hafnium and compounds (as Hf)	7440-58-6			N95	
Halothane	151-67-7	2-Bromo-2-chloro-1,1,1-trifluoroethane		OV	Short service life
Hard metals containing cobalt and tungsten				N95	
Heptane, all isomers	142-82-5 590-35-2 565-59-3 108-08-7 591-76-4 589-34-4	n-Heptane, normal Heptane		OV	3M Organic Vapor Monitors

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Hexachlorobenzene	118-74-1	Perchlorobenzene	Y	N95	
Hexachlorobutadiene	87-68-3	Hexachloro-1,3-butadiene, Perchlorobutadiene	Y	(F)OV	
Hexachlorocyclopentadiene	77-47-4			(F)OV	
Hexachloroethane	67-72-1	Perchloroethane	Y	OV/N95	
Hexachloronaphthalene	1335-87-1	Halowax™ 1014	Y	OV/N95	See comment D in Introduction
1,4-Hexadiene	592-45-0	1-Allylpropene		OV	
Hexafluoroacetone	684-16-2	1,1,1,3,3,3-Hexafluoro-2-propanone	Y	SA	Short OV service life
1,1,1,3,3,3-Hexafluoro-propane	690-39-1	FC-236fa, FE-13, HFC-236fa, Hydrofluorocarbon 236fa		SA	Ineffective sorbents
Hexafluoropropylene	116-15-4	1,1,2,3,3,3-Hexafluoro-1-propene; 1,1,2,3,3,3-Hexafluoropropylene; Fluorocarbon 1216; Hexafluoropropene; HFP; Perfluoro-1-propene; Perfluoropropene; Perfluoropropylene		SA	Short OV service life

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Hexahydrophthalic anhydride, All isomers	85-42-7 13149-00-3 14166-21-3	1,2-Cyclohexanedicarboxylic acid anhydride; 1,2-Cyclohexanedicarboxylic anhydride; 1,3-Isobenzofurandione, hexahydro; Cyclohexane-1,2-dicarboxylic anhydride, cis and trans mixture; Hexahydro-1,3-isobenzofurandione; Hexahydrophthalic acid anhydride; HHPA; HHPAA		OV/N95	See comment D in Introduction
Hexamethylene diisocyanate	822-06-0	HDI		OV/N95	
Hexamethylene -tetramine	100-97-0	Methenamine, Hexamine, Hexamethylenamine, HMT, HMTA, Foramine, Urotropin		MG/N95	
Hexane (n-hexane)	110-54-3	Hexyl hydride, Normal hexane	Y	OV	3M Organic Vapor Monitors
Hexane (other isomers)				OV	
1,6-Hexanediamine	124-09-4	1,6-Diaminohexane, Hexamethylenediamine, HMD, HMDA		OV/N95	
Hexanediol diacrylate	13048-33-4	HDODA; Propenoic acid,1,6-hexanediol ester		OV/P95	See comment D in Introduction

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
1-Hexene	592-41-6	Butyl ethylene, Hex-1-ene, Hexene, Hexene-n-1, Hexylene		OV	Short service life
sec-Hexyl acetate	108-84-9	1,3-Dimethylbutyl acetate, Methylamyl acetate, Methylisoamyl acetate, Methylisobutyl carbinol		(F)OV	See comment E in Introduction
Hexylene glycol	107-41-5	2-Methyl-2,4-pentanediol		(F)OV/P95	Irritation also provides warning
HFE-7100	163702-08-7 163702-07-6	60% of mixture is: 1-Methoxy-2-trifluoromethyl-1,1,2,3,3,3-hexafluoropropane; 1-Methoxyperfluoroisobutane 40% of mixture is: 1-Methoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane; 1-Methoxyperfluorobutane		OV	Short service life
Hydrazine	302-01-2	Anhydrous hydrazine	Y	(F)AM	
Hydrogenated terphenyls	61788-32-7	Hydrogenated terphenyls		R95 P95	
Hydrogen bromide	10035-10-6	HBr, Hydrobromic acid		AG	Not specifically approved for HBr
Hydrogen chloride	7647-01-0	HCl, Hydrochloric acid, Muriatic acid		AG	Irritation also provides warning
Hydrogen cyanide	74-90-8	Hydrocyanic acid, Prussic acid	Y	(F)SA	Low IDLH

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Hydrogen fluoride	7664-39-3	Anhydrofluoric acid, Etching acid, Fluoric acid, Fluorohydric acid, HF	Y	(F)HF	
Hydrogen peroxide	7722-84-1	Hydrogen dioxide, Peroxide		(F)OV	See technical data bulletin 185
Hydrogen selenide (as Se)	7783-07-5	Selenium hydride		(F)MG	
Hydrogen sulfide	7783-06-4	H <sub>2</sub> S, Hepatic gas, Hydrosulfuric acid, Sulfuretted hydrogen		AG	Poor warning (olfactory fatigue)
Hydroquinone	123-31-9	1,4-Benzenediol, Dihydroxybenzene, Quinol		(F)OV/N95	See comment D in Introduction
4-Hydroxybenzoic acid	99-96-7			(F)N95	
2-Hydroxypropyl acrylate	999-61-1	HPA	Y	OV	
Indene	95-13-6	Indonaphthene		OV	
Indium and compounds (as In)	7440-74-6			N95	
Indium tin oxide	50926-11-9			N95	90:10 mixture of In <sub>2</sub> O <sub>3</sub> and SnO <sub>2</sub>
Iodides				(F)MG/ N95	See comment E in Introduction

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Iodine	7553-56-2			(F)MG/ N95	See comment E in Introduction
Iodoform	75-47-8	Triiodomethane		(F)OV	
Iron oxide	1309-37-1	Burnt sienna, Burnt umber, Ferric oxide, Hematite, Jeweler's rouge, Rouge		N95	
Iron oxide fume	1309-37-1	Ferric oxide fume		N95	
Iron pentacarbonyl (as Fe)	13463-40-6	Iron carbonyl		SA	Unknown sorbent effectiveness
Iron salts, soluble (as Fe)		Ferric chloride; Ferric nitrate; Ferric sulfate; Ferric/Ferrous salts, soluble; Ferrous chloride; Ferrous sulfate		N95	
Isoamyl alcohol	123-51-3	3-Methyl-1-butanol, Fusel oil, Isobutyl carbinol, Isopentyl alcohol		(F)OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Isobutane	75-28-5	2-Methyl propane, Methylpropane		SA	Short OV service life
Isobutene	115-11-7	1,1-Dimethylethene, 1,1-Dimethylethylene, 2-Methylpropene, 2-Methylpropylene, Isobutylene		OV	Short service life
Isobutyl acetate	110-19-0	2-Methylpropyl acetate		(F)OV	3M Organic Vapor Monitors

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Isobutyl alcohol	78-83-1	2-Methyl-1-propanol, IBA, Isobutanol, Isopropylcarbinol		(F)OV	3M Organic Vapor Monitors
Isobutyl nitrite	542-56-3	IBN; Nitrous acid, 2-methylpropyl ester; Nitrous acid, isobutyl ester		OV	
Isobutyraldehyde	78-84-2	2-Methyl-1-propanal, 2-Methylpropanal, 2-Methylpropionaldehyde, Isobutanal, Isobutyl aldehyde, Isobutyric aldehyde, Valine aldehyde		OV	Short service life
Isocyanuric acid	108-80-5	Cyanuric acid, s-Triazine-2,4,6(1H,3H,5H)-trione, s-Triazinetriol		N95	AM/N95 may be preferable if wet
Isooctyl alcohol	26952-21-6	Isooctanol	Y	OV	
Isoflurane	26675-46-7	1-Chloro-1-(difluoromethoxy)-2,2,2-trifluoroethane, 1-Chloro-2,2,2-trifluoroethyl difluoromethyl ether		OV	See 3M technical data bulletin
Isophorone	78-59-1	3,5,5-Trimethyl-2-cyclohexene-1-one		OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Isophorone diisocyanate	4098-71-9	IPDI		OV/N95	
Isophthalic acid	121-91-5	1,3-Benzenedicarboxylic acid, IA , IPA, m-Phthalic acid		N95	



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Isoprene	78-79-5	2-Methyl-1,3-butadiene		OV	Short service life
Isopropoxyethanol	109-59-1	Ethylene glycol monoisopropyl ether, IPE, Isopropyl Cellosolve®, Isopropyl glycol	Y	OV	
Isopropyl acetate	108-21-4	Isopropyl ester of acetic acid, sec-Propyl acetate		(F)OV	3M Organic Vapor Monitors
Isopropylamine	75-31-0	2-Aminopropane, Monoisopropylamine		(F)AM (F)OV	AM not specifically approved, but 3M recommended for longer service life
N-Isopropylaniline	768-52-5	o-Aminoisopropylbenzene, o-Isopropylaniline	Y	OV	
Isopropyl ether	108-20-3	Diisopropyl ether		OV	
Isopropyl glycidyl ether	4016-14-2	1,2-Epoxy-3-isopropoxy-propane, IGE, Isopropoxymethyl-oxiran, Isopropyl epoxypropyl ether		(F)OV	
Kaolin (particles with no asbestos and <1% crystalline silica)	1332-58-7	Aluminium silicate, China clay		N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Kerosene (applications with negligible aerosol)	8008-20-6 64712-81-0 64742-81-0	Deobase, Diesel No.1, Fuel oil No. 1, JP-4, JP-5, JP-8, Hydrotreated kerosene, Kerosine	Y	OV	When aerosols present, add a particulate prefilter
Ketene	463-51-4	Carbomethene, Ethenone		(F)SA	Ineffective sorbents
Lead arsenate (as As)	3687-31-8			N100	
Lead chromate (as Cr)	7758-97-6	Chromates of lead, Chrome orange, Red lead chromate		N100	
Lead, elemental and inorganic compounds(as Pb)	7439-92-1			N100	
d-Limonene	5989-27-5	1-Methyl-4(1-methylethenyl) cyclohexene, 4-Isopropyl-1-methylcyclohexene, Cajeputene, Cinene, p-Mentha-1,8-diene		OV	3M Organic Vapor Monitors
Lithium fluoride (as F)	7789-24-4			N95	
Lithium hydride	7580-67-8			N95	
Lithium hydroxide	1310-65-2			N95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Lithium hydroxide monohydrate	1310-66-3			N95	
Lithium oxide	12057-24-8	Dilithium oxide, Lithium monoxide		N95	
LPG	68476-85-7	Bottled gas, Liquefied petroleum gas		SA	Mixture with compounds with short OV service life
Magnesite	546-93-0	Magnesium carbonate		N95	
Magnesium oxide fume	1309-48-4	Magnesia fume		N95	
Maleic anhydride	108-31-6	2,5-Furandione, cis-Butenedioic anhydride, Maleic acid anhydride		(F)OV/N95	See comment D in Introduction
Manganese cyclopentadienyl tricarbonyl	12079-65-1	MCT	Y	SA	Properties of vapor unknown
Manganese, elemental and inorganic compounds (as Mn)	7439-96-5			N95	
Melamine	108-78-1	1,3,5-Triazine-2,4,6-triamine, 2,4,6-Triamino-1,3,5-triazine, Cyanuramide		N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
2-Mercaptobenzo-thiazole	149-30-4	2-Benzothiazolethiol, 2-Benzothiazolylmercaptan, Benzothiazole-2-thione, Mercaptobenzothiazole	Y	N95	
Mercaptoethanol	60-24-2	1-Hydroxy-2-mercaptoethane, 2-Hydroxy-1-ethanethiol, 2-Hydroxyethylmercaptan, 2ME, 2-Mercaptoethanol, 2-Thioethanol, Thioethyleneglycol, Thioglycol	Y	OV	
Mercury, alkyl compounds (as Hg)			Y	OV	
Mercury, aryl compounds (as Hg)			Y	N95	Dust with essentially no vapor pressure only.
Mercury, inorganic compounds (as Hg)			Y	N95	Dust with essentially no vapor pressure only. Hg/N95 for volatile liquids
Mercury, metallic mercury vapor	7439-97-6	Hg, Quicksilver	Y	Hg	
Mesityl oxide	141-79-7	Isobutenyl methyl ketone, Isopropylidene acetone, Methyl isobutenyl ketone		(F)OV	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Methacrylic acid	79-41-4	a-Methacrylic acid		(F)OV	
Methane	74-82-8	Biogas, Fire damp, Marsh gas, Methyl hydride, R 50 (refrigerant)			Simple asphyxiant, oxygen displacing gas
2-Methoxyethanol	109-86-4	Ethylene glycol monomethyl ether, Methyl Cellosolve®	Y	OV	3M Organic Vapor Monitors
2-Methoxyethyl acetate	110-49-6	Ethylene glycol methyl ether acetate, Ethylene glycol monomethyl ether acetate, Methyl Cellosolve® acetate	Y	OV	3M Organic Vapor Monitors
4-Methoxyphenol	150-76-5	Hydroquinone monomethyl ether, p-Methoxyphenol		N95	
3-Methoxypropyl amine	5332-73-0	1-Propanimine, 3-methoxy		(F)OV (F)AM	Irritation also provides warning. AM may be preferred, but not specifically approved
Methyl acetate	79-20-9	Acetic acid methyl ester, Methyl acetic ester, Methyl ethanoate		OV	Short service life. 3M Organic Vapor Monitors.
Methyl acetylene	74-99-7	Allylene, Propyne		SA	Short OV service life
Methyl acetylene propadiene mixture	59355-75-8	MAPP gas, Methyl acetylene-allene mixture, Propyne-allene mixture		SA	Short OV service life
Methyl acrylate	96-33-3	Methyl propenoate	Y	(F)OV	3M Organic Vapor Monitors

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Methylacrylonitrile	126-98-7	2-Methyl-2-propenenitrile, Isoprene cyanide	Y	SA	
Methylal	109-87-5	Dimethoxymethane, Dimethylacetal formaldehyde, Formal, Methyl formal		SA	
Methyl alcohol	67-56-1	Carbinol, Methanol, Wood alcohol	Y	SA	Short OV service life. 3M Organic Vapor Monitors.
Methylamine	74-89-5	Monomethylamine		(F)AM	
Methyl amyl alcohol	108-11-2	Methyl isobutyl carbinol	Y	OV	3M Organic Vapor Monitors
Methyl n-amyl ketone	110-43-0	2-Heptanone, Amyl methyl ketone, Methyl amyl ketone, n-Amyl methyl ketone		OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Methylaniline	100-61-8	MA, Monomethyl aniline, N-Methyl aniline	Y	OV	
Methyl bromide	74-83-9	Bromomethane	Y	(F)SA	Short OV service life. Use of 60928 cartridge/filter recommended by 3M, not specifically approved for methyl bromide
2-Methyl-2-butene	513-35-9			SA	Short OV service life

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Methyl tert-butyl ether	1634-04-4	2,2-MMOP, 2-Methoxy-2-methyl-propane, MTBE, tert-Butyl methyl ether		OV	3M Organic Vapor Monitors
Methyl n-butyl ketone	591-78-6	2-Hexanone, MBK	Y	OV	3M Organic Vapor Monitors
Methyl chloride	74-87-3	Chloromethane	Y	SA	Short OV service life
Methyl chloroform	71-55-6	1,1,1-Trichloroethane		OV	3M Organic Vapor Monitors
Methyl 2-cyanoacrylate	137-05-3	Mecrylate		(F)OV	
Methylcyclohexane	108-87-2	Cyclohexylmethane, Hexahydrotoluene		OV	3M Organic Vapor Monitors
Methylcyclohexanol	25639-42-3	Hexahydrocresols		OV	
Methylcyclohexa -none, all isomers	583-60-8 591-24-2 589-92-4 1331-22-2	2-Methylcyclohexanone, 3-Methylcyclohexanone, 4-Methylcyclohexanone	Y	(F)OV	Irritation also provides warning
2-Methylcyclopenta -dienyl manganese tricarbonyl (as Mn)	12108-13-3		Y	OV/N95	SA preferable if heat involved
Methylene bisphenyl isocyanate	101-68-8	4,4-Diphenylmethane diisocyanate, MDI, Methylene-bis-(4-phenyl isocyanate)		OV/N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Methylene chloride	75-09-2	Dichloromethane, Methylene dichloride		(F)SA	OSHA requires (F)SA; no change schedule allowed. Short OV service life. 3M Organic Vapor Monitors.
4,4'-Methylene-bis-(2-chloroaniline)	101-14-4	4,4'-Methylene-bis-(2-chlorobenzamine), DACPM, MOCA	Y	OV/N95	See comment D in Introduction
Methylene-bis(4-cyclohexylisocyanate)	5124-30-1			OV/N95	
4,4'-Methylene dianiline	101-77-9	4,4'-Diaminodiphenylmethane, MDA	Y	N100	Use OV/N100 if heat is involved. See 29 CFR 1910.1050
Methyl ethyl ketone	78-93-3	2-Butanone, MEK		(F)OV	3M Organic Vapor Monitors
Methyl ethyl ketone peroxide	1338-23-4	MEKP		(F)OV	
Methyl ethyl ketoxime	96-29-7	2-Butanone oxime, MEKO		OV	3M Organic Vapor Monitors
Methyl formate	107-31-3	Formic acid methyl ester, Methyl methanoate		SA	Short OV service life
Methyl hydrazine	60-34-4	Monomethyl hydrazine	Y	(F)AM	



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Methyl iodide	74-88-4	Iodomethane	Y	(F)SA	Short OV service life. Use of 60928 cartridge/filter recommended by 3M, not specifically approved for methyl iodide. 3M Organic Vapor Monitors.
Methyl isoamyl ketone	110-12-3	2-Methyl-5-hexanone, 5-Methyl-2-hexanone, MIAK		(F)OV	3M Organic Vapor Monitors
Methyl isobutyl ketone	108-10-1	Hexone, MIBK		(F)OV	3M Organic Vapor Monitors
Methyl isocyanate	624-83-9	Isocyanic acid, methyl ester	Y	SA	Unknown sorbent effectiveness
Methyl isopropyl ketone	563-80-4	3-Methyl-2-butanone, MIPK		(F)OV	
Methyl mercaptan	74-93-1	Mercaptomethane, Methanethiol, Methyl sulfhydrate, Thiomethyl alcohol		OV	Short service life
Methyl methacrylate	80-62-6	2-Methyl-2-propenoic acid methyl ester; Methacrylic acid, methyl ester; Methyl alpha-methyl-acrylate; Methyl-2-methyl-2-propenoate; Methyl-2-methylpropenoate; MMA		OV	3M Organic Vapor Monitors
1-Methylnaphthalene	90-12-0	a-Methyl naphthalene, a-Methylnaphthalene	Y	OV/R95 OV/P95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
2-Methylnaphthalene	91-57-6	b-Methyl naphthalene, b-Methylnaphthalene	Y	OV/R95 OV/P95	
Methyl propyl ketone	107-87-9	2-Pentanone, Ethyl acetone, MPK		(F)OV	3M Organic Vapor Monitors
n-Methyl-2-pyrrolidone	872-50-4	1-Methyl-2-pyrrolidone; m-Pyrol; n-Methyl Pyrrolidone; NMP	Y	OV	3M Organic Vapor Monitors
Methyl silicate	681-84-5	Tetramethoxy silane		(F)OV	
a-Methyl styrene	98-83-9	1-Methyl-1-phenylethylene, AMS		OV	See comment E in Introduction
Methyltetrahydrod -phthalic anhydride isomers	3425-89-6, 5333-84-6, 11070-44-3, 19438-63-2, 19438-64-3, 26590-20- 5, 42498- 58-8		Y	OV	
Methyltrichlorosilane	75-79-6	Trichloromethylsilane		(F)AG/N95	Irritation also provides warning

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Methyl vinyl ketone	78-94-4	3-Buten-2-one, 3-Butene-2-one, Acetyl ethylene, d(3)-2-Butenone, g-Oxo-a-Butylene, Methyl vinyl acetone, Methylene acetone		OV	
Mica (less than 1% quartz)	12001-26-2			N95	
Mineral oil, excluding metal working fluids (pure, highly and severely refined)	8012-95-1	Liquid petrolatum, Paraffin oil, USP mineral oil, White mineral oil		R95 P95	
Molybdenum and insoluble compounds (as Mo)	7439-98-7			N95	
Molybdenum, soluble compounds (as Mo)	7439-98-7			N95	
Monochloroacetic acid	79-11-8	Chloroethanoic acid, MCAA	Y	(F)OV/N95	See comment D in Introduction
Monomethylformamide	123-39-7	N-Methylformamide	Y	(F)OV	
Morpholine	110-91-8	Diethylenimide oxide, Tetrahyrdo-1,4-oxazine	Y	(F)OV	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Naphtha (coal tar)	8030-30-6	Crude solvent coal tar naphtha, High solvent naphtha, Naphtha, Rubber solvent		(F)OV	Odor variable. Irritation also provides warning.
Naphthalene	91-20-3	Naphthalin, White tar	Y	OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Natural gas	8006-14-2				Simple asphyxiant, oxygen displacing gas
Natural rubber latex	9006-04-6	Caoutchouc, India rubber, Natural latex, Natural rubber, NRL, Polyisoprene, Rubber	Y	N95	
Nickel carbonyl (as Ni)	13463-39-3	Nickel tetracarbonyl		(F)SA	Unknown sorbent effectiveness
Nickel, elemental/metal compounds (as Ni)	7440-02-0			N95	
Nickel, insoluble inorganic compounds not otherwise specified (as Ni)				N95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Nickel, soluble inorganic compounds not otherwise specified (as Ni)				N95	
Nickel subsulfide (as Ni)	12035-72-2			N95	
Nicotine	54-11-5	3-(1-Methyl-2-pyrrolidyl) pyridine	Y	OV/P95	See comment D in Introduction
Nitric acid	7697-37-2	Aqua fortis, Hydrogen nitrate, Red fuming nitric acid, RFNA, WFNA, White fuming nitric acid		(F)SA	Ineffective sorbents
Nitric oxide	10102-43-9	Nitrogen monoxide, NO		SA	Ineffective sorbents
p-Nitroaniline	100-01-6	1-Amino-4-nitrobenzene, 4-Nitroaniline, Azoic diazo component 37, Fast Red GG base, p-Aminonitro-benzene, PNA	Y	OV/N95	See comment D in Introduction
Nitrobenzene	98-95-3	Nitrobenzol, Oil of mirbane	Y	OV	
p-Nitrochlorobenzene	100-00-5	1-Chloro-4-nitrobenzene, 4-Chloronitrobenzene, PCNB, PNCB	Y	OV	
Nitroethane	79-24-3			(F)OV	
Nitrogen dioxide	10102-44-0	Nitrogen peroxide		SA	Ineffective sorbents

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Nitrogen trifluoride	7783-54-2	Nitrogen fluoride		SA	Unknown sorbent effectiveness
Nitroglycerin (NG)	55-63-0	Glyceryl trinitrate, Trinitroglycerin	Y	OV	
Nitromethane	75-52-5	Nitrocarbolic acid		OV	
1-Nitropropane	108-03-2			OV	
2-Nitropropane	79-46-9	sec-Nitropropane		OV	
Nitrotoluene	88-72-2 99-08-1 99-99-0	Nitrotoluol	Y	OV/N95	See comment D in Introduction
5-Nitro-o-toluidine	99-55-8	2-Methyl-5-nitrobenzenamine, 5-Nitro-2-toluidine, Azoic Diazo Compound 12		OV/R95 OV/P95	
Nitrous oxide	10024-97-2	Dinitrogen monoxide		SA	Ineffective sorbents
Nonane	111-84-2	n-Nonane		OV	3M Organic Vapor Monitors
Octachloronaphthalene	2234-13-1	Halowax™ 1051	Y	OV/N95	See comment D in Introduction
Octane, all isomers	111-65-9 540-84-1	n-Octane, Isooctane		OV	3M Organic Vapor Monitors

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
1-Octanol	111-87-5	1-Hydroxyoctane, Alcohol C-8, Capryl alcohol, Heptyl carbinol, n-Octanol, n-Octyl alcohol		OV	
1-Octene	111-66-0	a-Octene, a-Octylene		OV	
Osmium tetroxide (as Os)	20816-12-0	Osmic acid		(F)SA	Unknown sorbent effectiveness
Oxalic acid	144-62-7	Ethane dioic acid		OV/N95	See comment D in Introduction
Oxalic acid dihydrate	6153-56-6			OV/N95	See comment D in Introduction
p,p-Oxybis (benzenesulfonyl hydrazide)	80-51-3	Benzenesulfonic acid, 4,4-Oxybis-dihydrazide; Celogen®; Diphenyl ether 4,4'-disulfohydrazide; OBSH		N95	
Oxygen difluoride	7783-41-7	Difluorine monoxide, Fluorine monoxide		SA	Unknown sorbent effectiveness
Ozone	10028-15-6			OZ	Respirators with nuisance level organic vapor relief recommended by 3M up to 10X OEL. Not NIOSH approved for ozone
Paraffin wax fume	8002-74-2			N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Particulates Not Otherwise Regulated		Nuisance particulates		N95	This category includes many materials. For oils, an R or P95 filter/respirator is recommended
Pentaborane	19624-22-7	Pentaboron nonahydride, Stable pentaborane		SA	Unknown sorbent effectiveness
Pentachloronaphthalene	1321-64-8	Halowax™ 1013	Y	OV/N95	See comment D in Introduction
Pentaerythritol	115-77-5	Tetramethylolmethane		N95	
Pentaerythritol triacrylate	3524-68-3	2-Propenoic acid, 2-(hydroxymethyl)-2-[[[(1-oxo-2-propenyl)oxy]methyl]-1,3-propanediyl]-ester, PETA		OV/P95	See comment D in Introduction
1,1,1,2-Pentafluoro-ethane	354-33-6	Fluorocarbon 125, HFC-125, Pentafluoroethane		SA	Ineffective sorbents
1,1,1,3,3-Pentafluoro-propane	460-73-1	Genetron® 245fa, HFC-245fa, R-245fa		SA	
Pentane, all isomers	109-66-0 78-78-4 463-82-1	n-Pentane		OV	Short service life. 3M Organic Vapor Monitors.
2,4-Pentanedione	123-54-6	Acetylacetone, Diacetylmethane	Y	OV	



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Pentyl acetate, all isomers	628-63-7 626-38-0 620-11-1 625-16-1 123-92-2 624-41-9	2-Acetoxy pentane, 3-Amyl acetate, n-Amyl acetate, sec-Amyl acetate, tert-Amyl acetate, Banana oil, 1,1-Dimethylpropyl acetate, Isoamyl acetate, Isopentyl acetate, 3-Methyl-1-butanol acetate, 1-Methylbutyl acetate, 2-Methylbutyl acetate, 3-Methylbutyl acetate, 2-Methylbutyl ethanoate, 1-Pentanol acetate, 2-Pentanol acetate, 1-Pentyl acetate, 2-Pentyl acetate, 3-Pentyl acetate		OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Peracetic acid	79-21-0	Acetic peroxide, Peroxyacetic acid		(F)OV/AG/ N95	See Technical Data Bulletin #185. See comment E in Introduction
Perchloroethylene	127-18-4	Perk, Tetrachloroethylene		(F)OV	3M Organic Vapor Monitors
Perchloromethyl mercaptan	594-42-3	PMM, Trichloromethyl sulfur chloride		OV	
Perchloryl fluoride	7616-94-6	Chlorine oxyfluoride		SA	Unknown sorbent effectiveness
Perfluorobutyl ethylene	19430-93-4	1H,1H,2H-Perfluorohexene; 1-Hexane, 3,3,4,4,5,5,6,6-nonafluoro; PFBE		OV	Short service life
Perfluoroisobutylene	382-21-8	Octafluoroisobutylene, Octafluoro-sec-butene; PFIB		SA	Short OV service life

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Persulfates, Ammonium	7727-54-0			N95	
Persulfates, Potassium	7727-21-1			(F)N95	
Persulfates, Sodium	7775-27-1			(F)N95	
Petroleum distillates	8002-05-9	Aliphatic petroleum naphtha, Petroleum ether (boiling range 95-115 degrees C), Petroleum naphtha		OV	Odor variable. See also Gasoline, Stoddard solvent. 3M Organic Vapor Monitors.
Phenol	108-95-2	Carbolic acid, Monohydroxy benzene	Y	OV/N95	
m-Phenylenediamine	108-45-2	1,3-Benzenediamine, m-Diaminobenzene		OV/N95	SA preferable if heat involved
o-Phenylenediamine	95-54-5	1,2-Benzenediamine, o-Diaminobenzene, Orthamine		OV/N95	SA preferable if heat involved
p-Phenylenediamine	106-50-3	1,4-Diaminobenzene, p-Diaminobenzene		OV/N95	SA preferable if heat involved
Phenyl ether, vapor	101-84-8	Diphenyl ether, Diphenyl oxide		OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Phenyl ether-biphenyl mixture vapor	8004-13-5	Diphenyl oxide-diphenyl mixture, Dowtherm™ A		OV	See comment E in Introduction

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Phenyl glycidyl ether	122-60-1	1,2-Epoxy-3-phenoxy propane, Glycidyl phenyl ether, Oxirane, PGE, Phenoxymethyl, Phenoxypropenoxide, Phenyl epoxypropyl ether	Y	OV	
Phenylhydrazine	100-63-0	Hydrazinobenzene	Y	(F)OV	
Phenyl isocyanate	103-71-9	Carbamil, Isocyanatobenzene, Phenyl carbamide		OV	
Phenyl mercaptan	108-98-5	Benzenethiol, Thiophenol		OV	
Phenylphosphine	638-21-1			OV	
Phosgene	75-44-5	Carbon oxychloride, Carbonyl chloride, Chloroformyl chloride		SA	
Phosphine	7803-51-2	Hydrogen phosphide, Phosphorus hydride		SA	6007/60927 recommended for certain applications. See technical data bulletin
2-Phosphono-1,2,4-butanetricarboxylic acid	37971-36-1	PBTC		N95	
Phosphoric acid	7664-38-2	m-Phosphoric acid, o-Phosphoric acid, White phosphoric acid		(F)N95	N95 acceptable with appropriate eye/face protection

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Phosphorus (yellow)	12185-10-3	White phosphorus, WP		SA	If no phosphorus vapor or phosphine gas present, N95
Phosphorus oxychloride	10025-87-3	Phosphoryl chloride		(F)AG	
Phosphorus pentachloride	10026-13-8	Phosphoric chloride		AG	
Phosphorus pentasulfide	1314-80-3	Phosphoric sulfide		N95	
Phosphorus trichloride	7719-12-2	Phosphorus chloride		(F)AG	
o-Phthalaldehyde	643-79-8	1,2-Benzenedialdehyde, OPA	Y	(F)OV/N95	3M Formaldehyde Monitors
Phthalic anhydride	85-44-9	1,3-Isobenzofurandione, PAN	Y	OV/N95	See comment D in Introduction
m-Phthalodinitrile	626-17-5	IPN, Isophthalodinitrile, m-Dicyanobenzene		OV/N95	See comment D in Introduction
o-Phthalodinitrile	91-15-6	1,2-Benzenedicarbonitrile, 1,2-Benzodinitrile, 1,2-Dicyanobenzene, o-Benzenedinitrile, Phtalic acid dinitrile		OV/N95	See comment D in Introduction
2-Picoline	109-06-8	2-Methyl-pyridine, a-Picoline	Y	OV	
3-Picoline	108-99-6	3-Methyl-pyridine, b-Picoline	Y	OV	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
4-Picoline	108-89-4	4-Methyl-pyridine, g-Picoline	Y	OV	
Picric acid	88-89-1	2,4,6-Trinitrophenol, Lyddite, Melinite, Pertite, Shimose		N95	
Piperazine and salts	110-85-0	1,4-Diazacyclohexane, Diethylenediamine, 1,4-Piperazine, Hexahydropyrazine, Piperazidine		OV/N95	See comment D in Introduction
Piperidine	110-89-4	Hexahydropyridine	Y	(F)OV	
Platinum metal (as Pt)	7440-06-4			N95	
Platinum soluble salts (as Pt)				(F)N95	
Polyethylene glycols	25322-68-3	PEG, PGE, Polyoxyethylene		R95 P95	See comment G in Introduction
Polypropylene glycols	25322-69-4	PPG		R95 P95	See comment G in Introduction
Polyvinyl chloride	9002-86-2	Cloroethene polymer, Cloroethylene homopolymer, Cloroethylene polymer, Polychloroethylene, PVC, Vinyl chloride homoploymer, Vinyl chloride polymer		N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Portland cement (containing no asbestos and <1% crystalline silica)	65997-15-1	Cement, Hydraulic cement, Portland cement silicate		N95	
Potassium bromate	7758-01-2	Bromic acid potassium salt		N95	
Potassium hydroxide	1310-58-3	Caustic potash, Lye, Potassium hydrate		N95	
Propane	74-98-6	Dimethyl methane, n-Propane		SA	Ineffective sorbents
2-Propanol	67-63-0	IPA, Isopropanol, Isopropyl alcohol, sec- Propyl alcohol		(F)OV	Irritation also provides warning. 3M Organic Vapor Monitors.
n-Propanol	71-23-8	1-Propanol, Ethyl carbinol, n-Propyl alcohol, Propan-1-ol		(F)OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Propargyl alcohol	107-19-7	2-Propyn-1-ol	Y	OV	
Propargyl bromide	106-96-7	1-Bromo-2-propyne; 3-Bromopropyne; Bromopropyne; gama-Bromoallylene; Propyne, 3-bromo	Y	OV	
2-Propenoic acid, Isooctyl ester	29590-42-9	IOA, Isoctyl acrylate		OV	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
b-Propiolactone	57-57-8	3-Hydroxy beta-lactone; 3-Hydroxypropionic acid; beta-Propiolactone; BPL; Hydroacrylic acid, beta-lactone; Propiolactone		(F)OV	OSHA requires SA with hood for certain applications; see 29 CFR 1910.1003
Propionaldehyde	123-38-6	1-Propanal, Methylacetaldehyde, Propylaldehyde		SA	Short OV service life. 3M Formaldehyde Monitors.
Propionic acid	79-09-4	Ethylformic acid, Methylacetic acid		(F)OV	
n-Propyl acetate	109-60-4	Acetic acid n-propyl ester, Propyl acetate		(F)OV	3M Organic Vapor Monitors
Propylene	115-07-1	1-Propene, 1-Propylene, Methylethene, Methylethylene, Propene		SA	
Propylene dichloride	78-87-5	1,2-Dichloropropane		OV	3M Organic Vapor Monitors
Propylene glycol, aerosol only	57-55-6	1,2-Dihydroxy propane, 1,2-Propanediol, Methyl glycol		R95 P95	See comment G in Introduction
Propylene glycol, vapor and aerosol	57-55-6	1,2-Dihydroxy propane, 1,2-Propanediol, Methyl glycol		OV/P95	See comment G in Introduction
Propylene glycol dinitrate	6423-43-4	1,2-Propanediol dinitrate, 1,2-Propylene glycol dinitrate	Y	(F)OV	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Propylene glycol ethyl ether	1569-02-4	Propylene glycol monoethyl ether	Y	(F)OV	
Propylene glycol monomethyl ether	107-98-2	1-Methoxy-2-propanol		OV	3M Organic Vapor Monitors
Propylene glycol monomethyl ether acetate	108-65-6	1-Methoxy-2-acetoxypropane, 1-Methoxy-2-propanol acetate, 2-Methoxy-1-methylethyl acetate, Glycol ether PM acetate, PGMEA		OV	3M Organic Vapor Monitors
Propyleneimine	75-55-8	2-Methylaziridine	Y	(F)OV	Short service life
Propylene oxide	75-56-9	1,2-Epoxypropane, 1,2-Propylene oxide, 2,3-Epoxypropane, Methyloxirane, Propene oxide		OV	Short service life. 3M Organic Vapor Monitors.
n-Propyl nitrate	627-13-4	Nitric acid n-propylester		OV	
Pyridine	110-86-1	Azabenzene, Azine		OV	3M Organic Vapor Monitors
Quinoline	91-22-5	1-Azabenzophthalene, 1-Benzazine, Chinoline, Lencol, Leukoline	Y	(F)OV	
Quinone	106-51-4	Benzoquinone, p-Benzoquinone		(F)OV/N95	



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Resorcinol	108-46-3	1,3-Benzenediol, m-Dihydroxybenzene		N95	OV/N95 may be preferable if heat is involved
Rhodium, metal and insoluble compounds (as Rh)	7440-16-6			N95	
Rhodium, soluble compounds(as Rh)				N95	
Selenium & compounds (as Se)	7782-49-2			N95	
Selenium hexafluoride	7783-79-1			SA	Unknown sorbent effectiveness
Silica, amorphous (diatomaceous earth)	61790-53-2	Diatomite, Silicon dioxide		N95	
Silica, crystalline	14808-60-7 1317-95-9 14464-46-1 15468-32-3	Crystallized silicon dioxide, Cristobalite, a-Quartz, Silica, Tripoli, Tridymite		N95	
Silicon	7440-21-3			N95	
Silicon carbide (fibrous)	409-21-2			N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Silicon carbide (nonfibrous particles with no asbestos and <1% crystalline silica)	409-21-2			N95	
Silicon tetrahydride	7803-62-5	Silane		SA	
Silver, metal and soluble compounds (as Ag)	7440-22-4			N95	
Soapstone (particles with no asbestos and <1% crystalline silica)		Massive talc, Soapstone silicate, Steatite		N95	
Sodium azide as hydrazoic acid vapor	26628-22-8	Hydrazoic acid vapor		SA	Unknown sorbent effectiveness
Sodium azide as sodium azide	26628-22-8	Hydrazoic acid (no vapor)		N95	
Sodium bisulfite	7631-90-5	Sodium hydrogen sulfite		AG/N95	N95 alone may be suitable if irritation eliminated
Sodium borate, anhydrous	1330-43-4	Borates, tetrasodium salts, anhydrous; Borax fused; Boric acid, disodium salt; Disodium tetraborate; Sodium tetraborate, anhydrous		N95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Sodium borate, decahydrate	1303-96-4	Borascu; Borates, tetrasodium salts, decahydrate; Borax; Borocin; Disodium diborate decahydrate; Disodium tetraborate decahydrate; Sodium pyroborate decahydrate; Sodium tetraborate, decahydrate		N95	
Sodium borate, pentahydrate	12179-04-3	Borates, tetrasodium salts, pentahydrate; Boric acid, pentahydrate; Boron sodium oxide, pentahydrate; Mule team borascu; Sodium tetraborate pentahydrate		N95	
Sodium chloroacetate	3926-62-3	Chloroacetic acid, sodium salt; Monoxone; Sodium monochloroacetate		N95	
Sodium fluoroacetate	62-74-8	1080, SFA, Sodium monofluoroacetate	Y	N95	
Sodium hydroxide	1310-73-2	Caustic soda, Lye, Soda lye		N95	
Sodium hypochlorite	7681-52-9	Hypochlorous acid, sodium salt; Sodium oxychloride		N95	Chlorine may also be present
Sodium metabisulfite	7681-57-4	Sodium pyrosulfite		AG/N95	N95 alone may be suitable if irritation eliminated
Starch	9005-25-8	Corn starch		N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Stearates	557-05-1; 557-04-0; 57-11-4; 822-16-2	Aluminium stearate, Calcium stearate, Glyceryl stearate, Lithium stearate, Magnesium stearate, Potassium stearate, Sodium stearate, Stearic acid, Zinc stearate		N95	
Stibine	7803-52-3	Antimony trihydride, Hydrogen antimonide		SA	Unknown sorbent effectiveness
Stoddard solvent	8052-41-3	Dry cleaning safety solvent, Mineral spirits		OV	3M Organic Vapor Monitors
Strontium chromate	7789-06-2	C.I. pigment yellow 32, Strontium yellow		N95	
Strychnine	57-24-9			N95	
Styrene	100-42-5	Cinnamene, Phenylethylene, Styrene monomer, Vinyl benzene		OV	3M Organic Vapor Monitors
Subtilisins	1395-21-7 9014-01-1	Proteolytic enzymes as 100% crystalline enzyme		SA	Difficult to measure 10X OEL. N95 acceptable with suitable air sampling data
Sucrose	57-50-1	Saccharose, Table sugar		N95	
Sulfur dioxide	7446-09-5	SO <sub>2</sub>		AG	Irritation and taste also provides warning

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Sulfur hexafluoride	2551-62-4	SF6		SA	Unknown sorbent effectiveness
Sulfuric acid	7664-93-9	Hydrogen sulfate, Matting acid, Oil of vitriol, Sulphuric acid, Vitriol brown oil		(F)N95	N95 acceptable with appropriate eye/face protection
Sulfur monochloride	10025-67-9	Sulfur chloride, Sulfur subchloride		(F)AG	
Sulfur pentafluoride	5714-22-7	Disulfur decafluoride		AG	
Sulfur tetrafluoride	7783-60-0			AG	
Sulfuryl fluoride	2699-79-8			SA	Unknown sorbent effectiveness
Synthetic vitreous fibers - Continuous filament glass fibers		Fibrous glass, dust; Glass, fibrous or dust		N95	
Synthetic vitreous fibers - glass wool fibers				N95	
Synthetic vitreous fibers - refractory ceramic fibers				N95	
Synthetic vitreous fibers - rock wool fibers		Mineral (rock), wool fiber		N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Synthetic vitreous fibers - slag wool fibers				N95	
Synthetic vitreous fibers - special purpose glass fibers				N95	
Talc (no asbestos and <1% crystalline silica)	14807-96-6	Hydrous magnesium silicate, Non-asbestiform talc, Non-fibrous talc, Steatite talc		N95	
Tantalum, metal and oxide dusts (as Ta)	7440-25-7			N95	
Tellurium and compounds (as Te, excluding hydrogen telluride)	13494-80-9			N95	
Tellurium hexafluoride (as Te)	7783-80-4			SA	Unknown sorbent effectiveness
Terephthalic acid	100-21-0	1,4 Benzenedicarboxylic acids, Benzene-p-dicarboxylic acid, p-Phthalic acid, Tephthol, TPA		N95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Terphenyls	26140-60-3	Diphenyl benzenes, Mixed terphenyls, m-Terphenyl, o-Terphenyl, p-Terphenyl		N95	OV/N95 may be preferable if heat is involved
1,1,2,2-Tetrabromo-ethane	79-27-6	Acetylene tetrabromide, Muthmann's liquid, Tetrabromoethane, Tetrabromoethylene		OV/N95	See comment E in Introduction
1,1,1,2-Tetrachloro-2,2-difluoroethane	76-11-9	2,2-Difluoro-1,1,1,2-tetrachloroethane, Freon® 112a, Halocarbon 112a, Refrigerant 112a		OV	
1,1,2,2-Tetrachloro-1,2-difluoroethane	76-12-0	Freon® 112, Halocarbon 112, Refrigerant 112		OV	
1,1,2,2-Tetrachloro-ethane	79-34-5	Acetylene tetrachloride	Y	OV	
Tetrachloronaphthalene	1335-88-2	Halowax™, Nibren wax, Seekay wax		OV/N95	See comment D in Introduction
2,3,5,6-Tetrachloro-pyridine	2402-79-1	Pyridine 2,3,5,6-tetrachloro-		OV/N95	See comment D in Introduction
Tetrachlorosilane	10026-04-7	Silicon chloride, Silicon tetrachloride		AG/N95	Reacts rapidly with moisture yielding HCl and silica
Tetraethylene glycol diacrylate	17831-71-9	2-Propionic acid, oxy-bis (2,1-ethanedioxy-2,1-ethanediol) ester, TTEGDA	Y	OV/P95	See comment D in Introduction

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Tetraethylene pentamine	112-57-2	1,2-Ethanediamine, N-(2-aminoethyl)-N'-(2-((2-aminoethyl)amino)ethyl), DEH 26, TEPA, Tetraethyl pentamine, Tetren 1,4,7,10,13-Pentaazatridecane	Y	(F)OV	
Tetraethyl lead (as Pb)	78-00-2	Lead tetraethyl, TEL	Y	OV	
1,1,1,2-Tetrafluoro-ethane	811-97-2	Fluorocarbon 134a, HFA 134a, HFC 134a, Tetrafluoroethane		SA	Ineffective sorbents
Tetrafluoroethylene	116-14-3	1,1,2,2-Tetrafluoroethylene, Fluoroplast 4, Perfluoroethene, Perfluoroethylene, Tetrafluoroethene, TFE		SA	
2,3,3,3-Tetrafluoro-propene	754-12-1			SA	
Tetrahydrofuran	109-99-9	Diethylene oxide, Tetramethylene oxide, THF	Y	OV	3M Organic Vapor Monitors
Tetrahydrofurfuryl alcohol	97-99-4	Tetrahydro-2-furancarbinol, Tetrahydro-2-furanmethanol, Tetrahydro-2-furylmethanol, THFA	Y	OV	
Tetrakis (hydroxymethyl) phosphonium chloride	124-64-1	Proban CC, Pyroset TKC, Retardol C, Tetrahydroxymethyl phosphonium chloride, THPC		N95	



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Tetrakis (hydroxymethyl) phosphonium sulfate	55566-30-8	bis Tetrakis-(hydroxymethyl) phosphonium sulfate, Octakis (hydroxymethyl) phosphonium sulfate, Pyroset TKO, Retardol S, THPS		N95	
Tetramethyl lead (as Pb)	75-74-1	Lead tetramethyl, TML	Y	OV	
Tetramethyl succinonitrile	3333-52-6	TMSN	Y	OV/N95	See comment D in Introduction
Tetranitromethane	509-14-8	Tetan		OV	
Tetryl	479-45-8	N-Methyl-N-2,4,6-tetranitroaniline; Nitramine; Tetralite; 2,4,6-Trinitrophenylmethyl nitramine		N95	
Thallium, elemental and soluble compounds (as Tl)	7440-28-0	Thallium acetate, Thallium carbonate, Thallium hydroxide	Y	N95	
4,4'-Thiobis(6-tert-butyl-m-cresol)	96-69-5	4,4'-Thiobis(3-methyl-6-tert-butylphenol)		N95	
Thioglycolic acid	68-11-1	Mercaptoacetic acid, Thioranic acid	Y	(F)OV	
Thionyl chloride	7719-09-7	Sulfur oxychloride, Sulfurous oxychloride		(F)AG	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Thiram (inhalable fraction and vapor)	137-26-8	Tetramethylthioram disulfide, TMT, TMTD, TMTDS		OV/N95	See comment D in Introduction
Tin and inorganic compounds, except SnH <sub>4</sub> and In <sub>2</sub> O <sub>5</sub> Sn (as Sn)	7440-31-5			N95	
Tin - organic compounds (as Sn)			Y	OV/N95	See comment D in Introduction
Titanium dioxide	13463-67-7	Anatase, Brookite, Rutile		N95	
Titanium tetrachloride	7550-45-0	Titanium chloride		AG/N95	
Toluene	108-88-3	Aantisal 1a, Methacide, Methyl benzene, Methylbenzol, Monomethyl benzene, Phenyl methane, Tol, Toluol, Tolu-sol		OV	3M Organic Vapor Monitors
Toluene diamine	25376-45-8 95-80-7	Diaminotoluene, TDA, Tolyenediamine	Y	N95	
Toluene-2,4-diisocyanate	584-84-9	2,4-TDI, 2,4-Toluene diisocyanate	Y	OV/N95	See comment E in Introduction
Toluene-2,6-diisocyanate	91-08-7	2,6-TDI, 2,6-Toluene diisocyanate	Y	OV/N95	See comment E in Introduction

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
p-Toluenesulfonyl chloride	98-59-9	4-Methyl-benzenesulfonyl chloride, Tosyl chloride		(F)OV/AG/N95	See comment D in Introduction. HCl and p-toluene sulfuric acid produced by hydrolysis
m-Toluidine	108-44-1	m-Aminotoluene	Y	(F)OV	
o-Toluidine	95-53-4	1-Methyl-1,2-aminobenzene, 2-Methylaniline, o-Aminotoluene, o-Methylaniline	Y	(F)OV	
p-Toluidine	106-49-0	p-Aminotoluene	Y	(F)OV	
Tributyl phosphate	126-73-8	TBP, Tri-n-butyl phosphate		OV/P95	See comment E in Introduction
Trichloroacetic acid	76-03-9	TCA		(F)OV/AG	Irritation also provides warning
1,2,4-Trichlorobenzene	120-82-1			OV	
1,1,2-Trichloroethane	79-00-5	b-Trichloroethane, Vinyl trichloride	Y	(F)OV	3M Organic Vapor Monitors
Trichloroethylene	79-01-6	1,1,2-TCE, 1-Chloro-2,2-dichloroethylene, Ethylene trichloride, TCE, Triclene™		OV	3M Organic Vapor Monitors

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Trichlorofluorome- thane	75-69-4	CFC-11, Fluorotrichloromethane, Freon™ 11, Refrigerant 11, Trichloromonofluoromethane		SA	Short OV service life
Trichloronaphthalene	1321-65-9	Halowax™, Nibren wax, Seekay wax	Y	OV/N95	See comment D in Introduction
1,2,3-Trichloropro- pane	96-18-4	Allyl trichloride, Glycerin trichlorohydrin, Glycerol trichlorohydrin, Trichlorohydrin	Y	(F)OV	
Trichlorosilane	10025-78-2	Silicochloroform		(F)AG	
1,1,2-Trichloro-1,2,2- trifluoroethane	76-13-1	FC-113, Freon® 113, Halocarbon 113, Refrigerant 113, TTE		SA	Short OV service life. 3M Organic Vapor Monitors.
Triethanolamine	102-71-6	2,2,2-Nitritotriethanol, Daltogen, Sterolamide, TEA, Trihydroxytriethylamine		OV/P95	See comment D in Introduction
Triethoxysilane	998-30-1	Silane, triethoxy-		(F)SA	Unknown sorbent effectiveness
Triethylamine	121-44-8	N,N-Diethylethanamine, N-Triethylamine, TEA		(F)OV	AM not specifically approved, but 3M recommended for longer service life
Triethylene glycol diacrylate	1680-21-3	2-Propenoic acid, 2-ethanediylbis-(oxy-2,1-ethanediyl) ester; TREGDA	Y	OV/P95	

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Triethylenetetramine	112-24-3	1,4,7,10-Tetraazadecane, 1,8-Diamino-3,6-diazaoctane, 3,6-Diazaoctane-1,8-diamine, N, N'-bis(2-aminoethyl)-1,2,ethane diamine, TECZA, TETA, Trientine	Y	OV	See comment E in Introduction. R or P filter, if filter required
Triethylphosphate	78-40-0	Phosphoric acid triethyl ester		OV/P95	
Trifluorobromomethane	75-63-8	Bromotrifluoromethane, Freon® 13B1, Halocarbon 13B1, Halon™ 1301, Refrigerant 13B1		SA	Short OV service life
1,1,1-Trifluoro-2,2-dichloroethane	306-83-2	FC-123, HCFC-123, Hydrofluorocarbon 123		SA	Short OV service life
1,1,1-Trifluoroethane	420-46-2	FC-143a, HFC-143a, Hydrofluorocarbon 143a		SA	Ineffective sorbents
2,2,2-Trifluoroethanol	75-89-8	2,2,2-Trifluoroethyl alcohol; Ethanol, 2,2,2,-Trifluoro; TFE		SA	Ineffective sorbents
1,3,5-Triglycidyl-s-triazinetrione	2451-62-9	1,3,5-Triazine-2,4,6-(1H,3H,5H)-trione, Araldite PT-810, TEPIC		N95	
Trimellitic anhydride	552-30-7	Anhydrotrimellitic acid, TMA, TMAN, Trimellitic acid anhydride		OV/N95	Chemical manufacturer's recommendation. See comment D in Introduction

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Trimethoxysilane	2487-90-3			(F)OV	
Trimethylamine	75-50-3	N,N-Dimethylmethanamine, N-Trimethylamine, TMA		(F)AM	AM not specifically approved, but 3M recommended for longer service life
Trimethyl benzene	25551-13-7	Hemimellitene, Mesitylene, Pseudocumene		OV	
Trimethylchlorosilane	75-77-4	Chlorotrimethylsilane, Monochlorotrimethylsilicon, Trimethyl chlorosilane		(F)OV/AG	
Trimethyl phosphite	121-45-9	Methyl phosphite, Phosphorus acid trimethylester		(F)OV	
Trimethylolpropane triacrylate	15625-89-5	2-Propenoic acid, 2-ethyl-2(((1-oxo-2-propenyl) oxy) methyl)-1,3-propanediyl ester	Y	OV/P95	
Trimethylolpropane trimethacrylate	3290-92-4	Acrylic acid, triester w/2-ethyl 2 (hydroxymethyl) 1,3 propanediol	Y	OV/P95	
2,4,6-Trinitrotoluene	118-96-7	sym-Trinitrotoluene, TNT, Trinitrotoluene, Trinitrotoluol	Y	OV/N95	See comment D in Introduction

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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Triorthocresyl phosphate	78-30-8	o-Tritolyl phosphate, TCP, TOCP, Tricresylphosphate	Y	R95 P95	See comment D in Introduction
Triphenyl phosphate	115-86-6	Phenyl phosphate, TPP		N95	OV/N95 may be preferable if heat is involved
Trisodium phosphate	7601-54-9	Sodium o-phosphate, TSP		(F)N95	N95 acceptable with appropriate eye/face protection
Tungsten and compounds, the absence of cobalt	7440-33-7			N95	
Turpentine	8006-64-2	Gum spirits, Gum turpentine, Turps, Wood turpentine		(F)OV	See comment E in Introduction
Uranium, insoluble compounds (as U)	7440-61-1			N95	See 10 CFR 20 subpart H
Uranium, soluble compounds (as U)	7440-61-1			N95	AG/N95 if halides. See 10 CFR 20 subpart H
Urea	57-13-6	Carbamide, Carbonyldiamide, Carbonyldiamine, Isourea		N95	AM/N95 may be preferable if heat is involved
n-Valeraldehyde	110-62-3	Pentanal, Valeric aldehyde		(F)OV	3M Formaldehyde Monitors
Vanadium pentoxide	1314-62-1	Vanadic anhydride, Vanadium oxide		N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Vanadium pentoxide fume	1314-62-1			N95	
Vanillin	121-33-5	Vanilla, Vanillaldehyde, Vanillic aldehyde		N95	
Vegetable oil				R95 P95	
Vinyl acetate	108-05-4	1-Acetoxyethylene, Ethenyl acetate		(F)OV	3M Organic Vapor Monitors
Vinyl bromide	593-60-2	Bromoethylene		(F)SA	Short OV service life
Vinyl chloride	75-01-4	Chloroethene, Chloroethylene, Monochloroethylene, VC, VCM, Vinyl chloride monomer		SA	OSHA allows OV for very short use periods. See 29 CFR 1910.1017. 3M Organic Vapor Monitors.
4-Vinylcyclohexene	100-40-3	1-Vinylcyclohexene-3, 4-Ethenyl-1-1-cyclohexene, 4-Vinyl-1-cyclohexene, 4-Vinylcyclohex-1-ene, 4-Vinylcyclohexene-1-butadiene dimer, VCH		OV	3M Organic Vapor Monitors
Vinyl cyclohexene dioxide	106-87-6	Vinylcyclohexane dioxide	Y	(F)OV	
Vinyl fluoride	75-02-5	Fluoroethene, Fluoroethylene, Monofluoroethylene		SA	Short OV service life



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Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Vinylidene chloride	75-35-4	1,1-Dichloroethylene, VDC		OV	Short service life. 3M Organic Vapor Monitors.
Vinylidene fluoride	75-38-7	1,1-Difluoroethene; 1,1-Difluoroethylene; Ethene,1,1-difluoro; Ethylene,1,1-difluoro; Halocarbon 1132A; VDF; Vinylidene difluoride		SA	Ineffective sorbents
N-Vinyl-2-pyrrolidone	88-12-0	1-Ethenyl-2-pyrrolidinone, 1-Vinylpyrrolidinone, N-Vinylpyrrolidinone, Vinylbutyrlactam, Vinylpyrrolidinone, Vinylpyrrolidone		OV	3M Organic Vapor Monitors
Vinyl toluene	25013-15-4	Methyl styrene, Tolyethylene		(F)OV	See comment E in Introduction. 3M Organic Vapor Monitors.
Vinyltrichlorosilane	75-94-5	Silane trichloroethenyl, Silane trichlorovinyl, Trichlorovinyl silicane, Trichlorovinylsilane, Trichlorovinylsilicon, Vinylsilicon trichloride		OV/AG	
Wood dust (All varieties except western red cedar)				N95	
Wood dust (Western red cedar)				N95	

Contaminant	CAS #	Synonym	Skin?	Respirator	Comments
Xylene (o-, m-, p-isomers)	1330-20-7 95-47-6 108-38-3 106-42-3	Dimethylbenzene (o-, m-, p-isomers), 1,2-Dimethylbenzene, 1,3-Dimethylbenzene, 1,4-Dimethylbenzene		OV	3M Organic Vapor Monitors
m-Xylene a,a'-diamine	1477-55-0	MXDA	Y	OV/N95	See comment D in Introduction
Xylidine	1300-73-8	Aminodimethyl benzene, Aminoxylene dimethyl aniline, Dimethylaminobenzene	Y	OV/N95	See comment E in Introduction
Yttrium, metal and compounds (as Y)	7440-65-5			N95	
Zinc chloride fume	7646-85-7	Zinc chloride fume		N95	
Zinc chromate	13530-65-9 11103-86-9 37300-23-5	Basic zinc chromate, Chromates of zinc, Zinc potassium chromate, Zinc yellow		N95	
Zinc oxide	1314-13-2	Zinc white, Zincite,		N95	
Zirconium and compounds (as Zr)	7440-67-7			N95	

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## Respirator Codes and Descriptions

(F)	Full Facepiece (with appropriate cartridges and filters)
AG	Acid Gas Respirator
AM	Ammonia/Methylamine Respirator
FORM	Formaldehyde Respirator
HF	Hydrogen Fluoride Respirator
Hg	Mercury Vapor Respirator
MG	Multi-gas/Vapor Respirator
N100	N100 Particulate Respirator
N95	N95 Particulate Respirator
OV	Organic Vapor Respirator
OZ	Ozone Respirator

P100	P100 Particulate Respirator
P95	P95 Particulate Respirator
R95	R95 Particulate Respirator
SA	Supplied Air Respirator
SA(F)	Supplied air respirator with full facepiece, helmet, hood or loose fitting facepiece

**Note:** Respirator abbreviations may be combined. For example, (F)OV/AG/P95 is a full facepiece respirator with an organic vapor/acid gas cartridge and a P95 particulate filter.

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