

Respirator Selection Criteria

The 3M™ Respirator Selection Guide includes a list of chemicals for which 3M respirators can be recommended. This information can be used to supplement general industrial hygiene knowledge. Once workplace contaminants and their concentrations have been identified, the Guide can be used to help select an appropriate 3M™ Respirator for nearly 700 chemicals with Threshold Limit Values (TLV®s) or other recommended exposure limits.

Because actual conditions vary from one worksite to another, this information is intended only as a guide. Selection of the most appropriate respirator will depend on the particular situation and should be made only by a person familiar with the working conditions and with the benefits and limitations of respiratory protection products. If you have any questions related to proper selection and use of 3M respirators, or the

use of this Guide, contact your local 3M OH&ESD representative or call our 3M OH&ESD Technical Service Line at 1-800-243-4630.

Respirator Program Management

Where respirators are in use in the workplace, a formal respiratory protection program must be established covering the basic requirements outlined in the OSHA Respiratory Protection Standard (29 CFR 1910.134). Education and training must be properly emphasized and conducted periodically. Maintenance, cleaning, and storage programs must be established and routinely followed for reusable respirators.

Respirator Fit

The OSHA Respiratory Protection Standard (29 CFR 1910.134) requires fit testing for all tight-fitting respirators. Whether you select a maintenance-free or a reusable respirator, the wearer must obtain a satisfactory fit as indicated by a qualitative or quantitative fit test. Worker comfort must also be considered. Removal of the respirator, even for short periods of time, dramatically reduces the protection afforded by the respirator.

Protection Factors

The respirator selected must have an assigned protection factor adequate for the particular workplace exposure. Divide the air contaminant concentration by the occupational exposure limit (OEL) to obtain a hazard ratio. Then select a respirator with an assigned protection factor greater than or equal to that hazard ratio.

Hazard Ratio

$$= \frac{\text{Airborne Contaminant Concentration}}{\text{OEL}}$$

Assigned protection factors* currently recommended by 3M are as follows:

Air Purifying Respirators

- Half facepiece (maintenance-free and dual cartridge).....10
- Full facepiece50

Powered Air Purifying Respirators

- Loose-fitting facepiece (e.g., H-200, Airstream™)25
- Half facepiece.....50
- Full facepiece, helmet, or hood1000

Supplied Air Respirators (airline)

- Continuous Flow
 - Loose-fitting facepiece (e.g., L-501)25
 - Half facepiece.....50
 - Full facepiece, helmet, or hood1000
 - Pressure Demand with Full facepiece1000
- Pressure Demand Airline with Escape SCBA**10,000, unknown and IDLH atmospheres
- Pressure Demand SCBA**10,000, unknown and IDLH atmospheres

Effects From Skin or Eye Contact

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.

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, faceshields, 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 and does not stay on the worker's face, it will not provide the protection needed.

*Assigned protection factors may vary for specific standards as promulgated by OSHA (e.g., continuous flow supplied air respirators are assigned a protection factor of 100 in the OSHA Asbestos Standards, 29 CFR 1910.1001 and 29 CFR 1926.1101). 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 use instructions and limitations.

Location Of Hazardous Area

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, an air purifying respirator or a combination air purifying/airline respirator may be appropriate.

Respirator Characteristics, Capabilities, and Limitations

A respirator may not be able to help protect against all of the contaminants present in a particular work environment. Specific limitations are stated on the approval labels and are included with use instructions and limitations. These must be carefully reviewed for each respirator before use. General precautionary information is given below. Refer to respirator packaging or operating manuals for specific information.



WARNING

No respirator is capable of preventing all airborne contaminants from entering the wearer's breathing zone. Respirators help protect against certain airborne contaminants by reducing airborne contaminant concentrations in the breathing zone to below the TLV or other recommended exposure level. **Misuse of respirators may result in overexposure to the contaminant and cause sickness or death. For this reason, proper respirator selection, training, use, and maintenance are mandatory in order for the wearer to be properly protected.**

Use these respirators only for those specific chemical compounds for

which they have been approved or recommended.

General Use Instructions

- Failure to follow all instructions and limitations on the use of these respirators and/or failure to wear them during all times of exposure can reduce respirator effectiveness and may result in sickness or death.
- Many of the contaminants that can be dangerous to a person's health include the ones that are so small they cannot be seen or smelled at dangerous levels.
- Before use of any respirator, the wearer must first be trained by the employer in proper respirator use in accordance with applicable safety and health standards.
- The OSHA Respiratory Protection Standard [29 CFR 1910.134(f)(1)] requires that the wearer of any tight-fitting respirator be fit tested.
- 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.

General Use Limitations

- These respirators do not supply oxygen.
- Do not use when concentrations of contaminants are immediately dangerous to life or health, when concentrations are unknown, or in atmospheres containing less than 19.5% oxygen, unless using an SCBA or combination airline/SCBA.
- Do not abuse or misuse any respirator.
- 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.
- Do not use when concentrations exceed maximum use concentrations established by regulatory agencies.



WARNING

These respirators help protect against airborne particles or gases and vapors only. Many of these substances can cause serious health effects, including sickness or death. Misuse of a respirator may result in sickness or death. For proper use, see a supervisor, refer to the respirator package, or call 3M OH&ESD Technical Service at 1-800-243-4630.

Format Explanation

Chemical Name

Chemical names listed in this Guide are generally those used in the Threshold Limit Values and Biological Exposure Indices for 2003 published by the American

Conference of Governmental Industrial Hygienists (ACGIH). Pesticides and chemicals without established occupational exposure limits are not included. Call 3M OH&ESD Technical Service for assistance in selecting respirators for these chemicals.

IDLH Level

This is the concentration considered Immediately Dangerous to Life or Health (IDLH), as published by the National Institute for Occupational Safety and Health (NIOSH) (DHHS [NIOSH] Publication No. 90-117). It specifically refers to the acute respiratory exposure that poses an immediate threat of loss of life, immediate or delayed irreversible adverse effects on health, or acute eye exposure that would prevent escape from a hazardous atmosphere. The reasons NIOSH established an IDLH at a particular level for a specific chemical are described in Documentation for Immediately Dangerous to Life or Health Concentrations (IDLHs), NTIS Publication No. PB-94-195047, May 1994.

The 1994 IDLH values established by NIOSH used interim criteria, and OSHA stated in a May 21, 1996 Memorandum that OSHA will use the older IDLH values while NIOSH conducts further study regarding the 1994 values. The 1990 IDLH values are used in this Guide since OSHA uses these values for enforcement. For those substances with no IDLH listed, the manufacturer or supplier may have additional chemical information. The Chemical Referral Center operated by the Chemical Manufacturers Association can assist in providing telephone numbers for obtaining information from manufacturers. The lower explosive level (LEL) and the concentration that would result in an oxygen deficient atmosphere should also be considered to be IDLH.

Odor Threshold*

Odor thresholds can no longer be used as the primary indicator for changing gas and vapor cartridges as a result of the revised OSHA standard, 29 CFR 1910.134. The respirator program administrator, using

sources, the other references were used. A few odor thresholds published in other documents were used when not listed in the references below (e.g., AIHA WEEL documentation). The method of defining and determining odor thresholds varies widely, thereby giving rise to a significant range of reported odor thresholds for many substances. Individuals may also respond differently to the same odor. At a given concentration, one person may smell and recognize the odor, while another person may barely notice it. The odor thresholds reported in the literature are typically determined for a single constituent, with no other chemicals present in the air. The single constituent situation rarely occurs in the workplace. Therefore, caution must be exercised in using these numbers. They may not be representative of odor detection capabilities of individual workers in your facilities. On the other hand, experience may indicate better warning properties than what is indicated by the reported value.

- The 2003 Workplace Environmental Exposure Levels (WEEL) from the American Industrial Hygiene Association is listed when it is the most stringent value or there is no TLV or PEL.
- The occupational exposure limits refer to **Time Weighted Average (TWA)** concentrations for a normal eight (8) hour workday and a forty (40) hour workweek, unless referenced as a ceiling or STEL.
- **Ceiling** OELs refer to concentrations that should not be exceeded during any part of the working exposure.
- **Short-Term Exposure Limit (STEL)** is a 15-minute time weighted average exposure which should not be exceeded at any time during a workday.
- **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.
- For a more detailed explanation of TLVs and their proper application, refer to the TLV booklet available for a nominal fee

objective data and information, must now establish chemical cartridge change schedules. The established change schedule should result in replacing the cartridges with new ones before their service life is depleted under the conditions of that workplace. Reported odor thresholds will continue to be listed in the Guide because odor can be useful as a secondary or backup indicator for cartridge change-out. The primary references for odor thresholds were VOCBASE and an American Industrial Hygiene Association (AIHA) publication. When an odor threshold value was not published in either of these two

OEL

- The occupational exposure limits listed are 2003 ACGIH **Threshold Limit Values (TLVs)**, unless otherwise stated. The concentrations are expressed in ppm —parts per million (parts of contaminant per million parts of air) — unless specifically stated as mg/m³ (milligrams of contaminant per cubic meter of air) or some other unit.
- An asterisk(*) indicates that the TLV is lower than the PEL.
- The OSHA **Permissible Exposure Limit (PEL)** is listed when it is more stringent than the current TLV.

from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240.

Synonyms

Several common synonyms are listed in this column.

Respirator Recommendations (to 10X OEL)

This column lists the 3M recommended respirator for exposure levels not exceeding ten times (10X) the OEL. **Do not exceed maximum use concentrations established by regulatory agencies. When a chemical cartridge respirator is**

*Odor Threshold References

1. Jensen, B., and P. Wolkoff. VOCBASE: Odor Thresholds, Mucous Membrane Irritation Thresholds and Physio-Chemical Parameters of Volatile Organic Compounds. [Computer Software]. National Institute of Occupational Health, Denmark, 1996.
2. Odor Thresholds for Chemicals with Established Occupational Health Standards. American Industrial Hygiene Association (1989).
3. Amooe, J.E. and E. Hautula. Odor as an Aid to Chemical Safety. J. Appl. Toxicol. 3(6):272-290 (1983).

4. Fazzuluri, F.A. Compilation of Odor and Taste Threshold Values Data. American Society for Testing and Materials (1978).
5. Verschuere, K. Handbook of Environmental Data on Organic Chemicals. pp. 12-21. Van Nostrand Reinhold, NY (1977).
6. Warning Properties of Industrial Chemicals—Occupational Health Resource Center, Oregon Lung Association.
7. Electrical Safety Practices, ISA Monograph #113 (1972).
8. Documentation of TLVs and BEIs. American Conference of Governmental Industrial

- Hygienists. 7th edition (2003).
9. Gemert, L.J. Van and A.H. Nettenbreijer. Compilation of Odor Threshold Values in Air and Water. CIVO-TNO, Netherlands (1977).
10. Gemert, L.J. Van. Compilation of Odor Threshold Values in Air, Supplement IV, CIVO-TNO, Zeist, Netherlands (1982).
11. Workplace Environmental Exposure Levels, American Industrial Hygiene Association (2003).
12. Ruth, J.H. Odor Thresholds and Irritation Levels of Several Chemical Substances: A Review. Am. Ind. Hyg. Assoc. J. 47(3):A-142-A-151 (1986).

recommended (e.g., OV) it can only be used if a cartridge change schedule is established as described in 29 CFR 1910.134 (d)(3)(iii) (B)(2). If a change schedule is not established, an airline respirator must be used. The SA code indicates that chemical cartridge respirators should not be used. Generally this is because of one of the three reasons described in the Comments column. These recommendations are valid only if the respirator selection process outlined on pages 11-14 is followed. The abbreviations used are explained in the Respirator Identification Key in the back pocket insert. All of these respirators have not been **specifically** tested against each compound listed. 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 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. The Identification Key lists these respirators as full facepiece air purifying respirators. For concentrations not exceeding ten times (10X) the OEL, half facepiece respirators (maintenance-free or reusable) with equivalent filters or cartridges may be suitable if appropriate eye protection is provided.**

For concentrations greater than ten times (10X) the OEL, follow the protection fact or guidelines in specific OSHA standards, or refer to the instructions in the

Respirator Selection Criteria and How To Use This Guide sections of this guide.

Comments

Other information may be listed in this column:

- A. **Short service life** means predicted cartridge life of less than 30 minutes at concentrations of ten times (10X) the OEL. Actual service life will vary considerably, depending on concentration levels, temperature, humidity, work rate, etc. See the following literature references for specific details on the conditions and limitations of these estimates:
1. 3M Company. 3M Respirator Service Life. [Computer Software] 3M OH&ESD, www.3M.com/occsafety.
 2. Smoot, D.M. Organic Vapor Respirator Service Life Prediction. Prepared Under NIOSH Contract No. 210-76-0108. Published October 1977.

3. Nelson, G.O. and C.A. Harder. Respirator Cartridge Efficiency Studies: V. Effect of Solvent Vapor. Am. Ind. Hyg. Assoc. J. 35(7): 391-410 (1974).

Typically, an airline respirator is recommended because the service life may be so short that the frequency required for changing the cartridges may not be practical.

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. 3M does not recommend using a chemical cartridge respirator or attempting to establish a change schedule for these chemicals.

- B. References to a **respirator not being specifically approved** refer to

approvals for that particular substance only. All respirators listed in this guide are NIOSH approved for specific substances and/or conditions.

- C. References to **warning** refer to odor or irritation warning properties of the substances. Where listed as unknown, no literature reference was located. Where listed as questionable, a wide range of reported odor thresholds exists. Air purifying respirators may be acceptable for these substances if you follow the requirements for establishing a change schedule acceptable to OSHA.
- D. These compounds have been identified as possibly existing in both particulate and vapor phase by a method published by Perez and Soderholm. 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 by Perez and Soderholm. 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

* 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).

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. Listing of 3M **3510, 3530, 3550**, or **3720** refers to a 3M™ Monitor which may be used to measure the amount of contaminant in the air. 3M Monitors may also be used to sample for other materials with analysis performed by a private laboratory. You should check with the laboratory to determine what other chemicals can be measured with

liquid airborne particulate hazard that does not contain oil. Generally these filters should be used and reused subject only to considerations of hygiene, damage, and increased breathing resistance.

N95 Particulate Filter -At least 95% filter efficient when tested with ~0.3 µm NaCl aerosol. 3M has replaceable filters and filtering facepiece respirators in this category.

N100 Particulate Filter -At least 99.97% filter efficient when tested with ~0.3 µm NaCl aerosol. 3M has a filtering facepiece respirator in this category.

R-Series Filters: A filter intended for removal of any particle including oil-based liquid aerosol. They may be used for any solid or liquid airborne particulate hazard. If the atmosphere contains oil, the R-series filter should be used only for a single shift (or for 8 hours of continuous or intermittent use).

R95 Particulate Filter -At least 95% filter efficient when tested with ~0.3 µm DOP (Diocetyl Phthalate) aerosol. 3M makes filtering facepiece respirators in this category.

P-Series Filters: A filter intended for removal of any particle including oil-based liquid aerosols. They may be used for any solid or liquid particulate airborne hazard. NIOSH requires that respirator manufacturers establish time-use limitations for all P-series filters. 3M recommends that P-series filters should be used and reused for no more than 40 hours of use or 30 days, whichever occurs first, in atmospheres that contain only oil aerosols, unless the filter needs to be changed for hygiene reasons, is damaged, or becomes difficult to breathe

through before the time limit is reached. When used in atmospheres containing non-oil aerosol, 3M P-series filters should be used and reused subject to conditions of hygiene, damage and increased breathing resistance.

P95 Particulate Filter -At least 95% filter efficient when tested with ~0.3 µm DOP (Diocetyl Phthalate) aerosol. 3M makes replaceable filters and filtering facepiece respirators in this category.

P100 Particulate Filter -At least 99.97% filter efficient when tested with ~0.3 µm DOP (Diocetyl Phthalate) aerosol. 3M makes replaceable filters and filtering facepieces in this category.

Oil: Any of numerous 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.

the monitors. An estimate of the air borne concentration is needed for making appropriate respirator selection and establishing a cartridge change schedule.

Contact the toll free 3M OH&ESD Technical Service Line at **1-800-243-4630** if you have questions about the use of this Guide or the proper selection and use and limitations of any 3M respirators.

Respirator Filter Definitions

3M 42 CFR 84 Filters

N-Series Filters: These filters are restricted to use in those atmospheres free of oil aerosols. They may be used for any solid or

* 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).

How to Use This Guide

If a respirator is being selected for a single compound listed in this guide with an air concentration not exceeding 10 times the value in the TLV column, then the respirator identified in the **Respirator Recommended** column may be selected. If a particulate filter respirator is recommended (any respirator code with N95, N100, R95, P95 or P100 in it) and a mineral, vegetable or synthetic oil or other oily material is also present in the air, you must select a respirator that provides the same efficiency but is acceptable for oil aerosols (see Oil definition). For example, if a respirator is being selected for beryllium dust at a concentration 2 times the exposure limit, the Guide lists **N95**. This code indicates a half-facepiece respirator with an N95 particulate filter. If an oil mist is present (air concentration greater than 0.1 mg/m³, but less than the occupational exposure limit) either an R- or P-series filter must be selected, even though respiratory protection is not needed for the oil mist. Therefore, the minimum recommended respirator would be **R95** or **P95**. These codes indicate a half-facepiece respirator with an R95 or P95 particulate filter. These codes can be

found in the **Respirator Codes and Descriptions** section located in the fold-out back cover of this guide.

If respiratory protection is desired for an atmosphere with more than one chemical or for an air concentration that exceeds either the IDLH value or 10 times the value in the TLV column, you must follow the directions below for proper respirator selection. If you need help, call 3M Technical Service at 1-800-243-4630.

Oil: Any of numerous 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.

1. Identify the air contaminants present in the workplace. Include chemical name and form. Classify particulate contaminants as oil or non-oil material. If the chemical is listed in this guide, it is classified. For help, see definition of oil. The material safety data sheet (MSDS) can be helpful with this step. Consider particulate contaminants oil

if unknown or not sure. List the contaminants on the form contained in this Guide or on your own form. Go to Step 2.

2. Determine the air concentration of the contaminant. Air sampling is recommended. Consideration should be given to TWA, short term and peak (ceiling) exposures, while keeping in mind seasonal and worker variability and the specific process being used. If air sampling data are not available and sampling is not practical, historical information from similar processes or analogous operations may be helpful for calculating maximum exposures and evaluating potential health effects. Record the airborne concentration(s) on the form provided or your own form. Go to Step 3.
3. Is the airborne concentration unknown?
 - a) If **yes**, go to Step 16.
 - b) If **no**, go to Step 4.
4. Is the oxygen concentration less than 19.5% or does the potential exist for the oxygen concentration to fall below 19.5%?
 - a) If **yes**, go to Step 16.
 - b) If **no**, go to Step 5.

5. Is the chemical listed in the Guide?
 - a) If **yes**, go to Step 6.
 - b) If **no**, go to Step 15.
6. Record the IDLH value and the value from the TLV column on the form provided or on one you created. Determine the hazard ratio (see page 2) and record. Using this information, determine which condition describes your situation:
 - a) Does the airborne concentration exceed the IDLH value? If **yes**, go to Step 16.
 - b) Does the hazard ratio exceed (>) 1000? If **yes**, go to Step 16.
 - c) Does the hazard ratio exceed (>) 50? If **yes**, go to Step 7.
 - d) Does the hazard ratio exceed (>) 10? If **yes**, go to Step 8.
 - e) Is the hazard ratio less than or equal to (\leq) 10? If **yes**, go to Step 9.
7. Select one of the following respirators: (1) a full facepiece, helmet or hood supplied air respirator or (2) a powered air purifying respirator (PAPR) with the same cartridge type as listed in the Guide under the Respirator Recommended column. To determine what type of PAPRs are

available, check the Respirator Identification Key. If a PAPR is selected, use a HEPA filter if an N, R, or P-series filter is listed. If the Guide lists SA or SA(F) even though the hazard ratio is less than or equal to 10, an SA(F) must be used. A PAPR cannot be used. For example: For an exposure to vinyl toluene with a hazard ratio of 90, an SA(F) or (F)PAPR/OV must be selected. The (F)PAPR/OV is acceptable because the OV cartridge is listed in the Respirator Recommended column. The service life of the OV cartridge must be considered to determine if the (F)PAPR or SA(F) is the better selection given the high exposure concentrations. If the exposure was to 4-vinylcyclohexene, an SA(F) must be selected. A PAPR could not be selected. Record the respirator you selected in the last column of the form for that chemical. Go to Step 10.

8. Select either a supplied air respirator or a full facepiece respirator with filters and/or chemical cartridges listed in the Guide under the Respirator Recommended column. If the Guide lists SA or SA(F), you must select the respirator recommended. Do not use air purifying respirators. For example: For an exposure to benzene with a hazard ratio of 30 (15 ppm), an (F)OV could be selected. For the same exposure conditions to benzyl acetate, an SA must be selected. Record the respirator you selected in the last column of the form for that chemical. Go to Step 10.
9. Select the respirator listed in the Respirator Recommended column. Record the respirator you selected in the last column of the form for that chemical. Go to Step 10.
10. Are any other air contaminants present at the same time?
 - a) If **yes**, go to Step 2 and repeat the procedure, recording the appropriate information for the next chemical. When two or more contaminants that act upon the same organ system are present, consideration should be given to the combined effect rather than individual effects. Consult the current edition of Exposure Indices published by the American Conference of Governmental Industrial Hygienists for more information and the appropriate

- formula. If combined effects are considered, calculate the hazard ratio for the mixture.
- b) If **no**, go to Step 11.
11. Are any of the respirators listed in the last column a particulate filter respirator (i.e., does it have an N, R or P filter?)?
- a) If **yes**, go to Step 12.
b) If **no**, go to Step 14.
12. Are only N-series particulate filter respirator(s) listed?
- a) If **yes**, go to Step 13.
b) If **no**, go to Step 14.
13. Is airborne oil mist present that has not been considered as a result of one of the following conditions: (1) was not listed as a contaminant or (2) is the oil mist concentration greater than 0.1 mg/m³ but less than the value in the TLV column of the Guide? A respirator is not required for the oil. If a respirator is not being selected for the oil, the presence of the oil must still be considered when choosing the appropriate filter. a) If **yes**, a respirator with either an R- or P-series filter must be
14. Was more than one respirator type required for the specific exposure situation (i.e., is there more than one respirator code included in the list made in the last column of the form?)? A respirator must be selected that satisfies all of the requirements listed in the last column.
- a) If **yes**, note all respirators recommended. If your list contains more than one respirator and all are air-purifying respirators, select from the Identification Key the one with the highest assigned protection factor (see page 2) and one that removes all of the contaminants, if available. If **SA** or **SA(F)** is one of the respirators listed in the last column, this respirator must be selected over all others. If any of the respirator codes contain the **(F)** designation, respirators with half facepieces cannot be used. If no air-purifying respirator will provide the protection required, select **SA** or **SA(F)** from the Respirator Identification Key. Go to Step 17.

- and would like help, go to Step 17. If no exposure limit is known, go to Step 16.
16. These conditions (unknown, <19.5% O₂, >IDLH) are generally considered as IDLH or the hazard ratio exceeds 1000. Select either a positive pressure self-contained breathing apparatus (SCBA) or combination respirator consisting of a positive pressure supplied air respirator with an auxiliary SCBA. The rated duration of the auxiliary SCBA should be sufficient to allow adequate time for escape. If 5 minutes is sufficient escape time, the 3M™ Air-Mate™ Combination Escape SCBA is acceptable (see Respirator Identification Key: Code SCBA). Record the respirator selected in the final row of the form. This is the minimum acceptable level of respiratory protection; the selection process is finished. If you need help, go to Step 17.

Note: If a chemical cartridge respirator is selected, you must establish a change schedule based on objective information and data. The information relied upon and the basis for the

selected. R-series filters must be changed after 8 hours use or after the respirator is loaded with or exposed to 200 mg of aerosol. The manufacturer's service time recommendation must be followed for P-series filters. To choose a respirator that provides the same degree of protection as originally identified, but with an R- or P-series filter, consult the Respirator Identification Key. Record the respirator with the R- or P-series filter that is being selected. Go to Step 14.
b) If **no**, go to step 14.

- b) If **no**, record the respirator listed in the last column as the final respirator selected (bottom line). A respirator meeting this description can be found by locating the code on the Respirator Identification Key. Go to Step 17.
15. If the chemical is not listed in the Guide, an occupational exposure limit either does not exist or was not located. Since it is not known what an acceptable exposure level is, a respirator cannot be recommended. If you have an exposure level for the material

cartridge change schedule and the basis for reliance on the data must be described in the respiratory protection program.

17. Do you need help?
- a) If **yes**, call 3M for assistance at 1-800-243-4630. Follow the recommendations given.
b) If **no**, order the selected respirator(s) from the local 3M Sales Representative or Distributor.

Respirator Selection Form

Chemical Name	Air Concentration	IDLH	TLV/PEL /WEEL	Hazard Ratio	Respirator Recommended

Respirator Selected:

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Acetaldehyde	10,000	0.186	25* (ceiling)	Ethanal, Acetic aldehyde	(F)OV (F)Form	Short OV service life
Acetic acid	1000	0.016	20	2-Butoxyethyl acetate, 2-Butoxyethanol acetate, Butylglycol acetate, Ethylene glycol monobutyl ether acetate, Glycol monobutyl ether acetate, Glacial acetic acid, Methane carboxylic acid, Ethanoic acid, Vinegar acid	(F)OV	
Acetic anhydride	1000	0.029	5	Ethanoic anhydride, Acetic acid anhydride, Acetyl oxide	(F)OV	
Acetone	20,000	4.58	500*	2-Propanone, Dimethyl ketone, Ketone propane	OV	3M 3530 Monitor
Acetone cyanohydrin		3	2 -skin- (AIHAWHEEL)	a-Hydroxy isobutyronitrile, 2-Propane cyanohydrin, 2-Cyano-2-propanol, 2-Methylacetonitrile, 2-Hydroxy-2-methyl propanenitrile	OV	Poor warning. 4.7 ppm TLV-C.
Acetonitrile	4000	97.7	20 -skin-	Cyanomethane; Ethane nitrile; Ethyl nitrile; Methanecarbonitrile; Methyl cyanide	OV	Poor warning. 3M 3530 Monitor.
Acetophenone		0.363	10	Methyl phenyl ketone, Acetyl benzene, Benzoyl methide, Hyponone, 1-Phenylethanone	OV	See Comment E, page 8
Acetylene dichloride				(See 1,2-Dichloroethylene)		
Acetylene tetrabromide	10		1	Tetrabromoethane	OV	Warning unknown
Acetylsalicylic acid			5 mg/m ³	Aspirin	N95	
Acrolein	5	0.174	0.1 (ceiling) -skin-	Acrylic aldehyde, Acrylaldehyde, Propenal, Allylaldehyde	(F)OV	Poor warning
Acrylamide			0.03 mg/m ³ * -skin-	Propenamide, Acrylamide monomer, Acrylic amide	OV/N95	See Comment D, page 7
Acrylic acid		0.4	2* -skin-	Acroleic acid, Propenoic acid	(F)OV	
Acrylonitrile	500	16.6	2 -skin-	Propenenitrile, AN, Vinyl cyanide	OV	Poor warning. SA if cartridge not disposed of after shift, per 29 CFR 1910.1045. 3M 3510 Monitor.
Adipic acid			5 mg/m ³	Hexanedioic acid; 1,6-Hexanedioic acid; 1,4-butanedicarboxylic acid Adipinic Acid	(F)N95	

* TLV is lower than PEL.

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Adiponitrile			2 -skin-	Addipic acid dinitrile; Hexanedinitrile; 1,4-dicyanobutane; Tetramethylene cyanide	OV	Warning unknown
Allyl alcohol	150	0.47	0.5* -skin-	2-Propenol, 2-Propen-1-ol, Vinyl carbinol	(F)OV	3M 3510 Monitor
Allyl chloride	300	0.489	1	3-Chloropropene, 1-Chloro-2-propene	OV	
Allyl glycidyl ether	270		1	AGE; 1-Allyloxy-2,3-epoxy-propane	(F)OV	Warning unknown. PEL-10 ppm ceiling.
Allyl isothiocyanate		0.035	1 (AIHAWHEEL)	Oil of mustard, AITC, Allyl thiocarbamide, 3-Isothiocyanate-1-propene, Allyl isosulfocyanate	OV	15 minute TWA. SA if used with acids.
Allyl propyl disulfide			2	Onion oil	(F)OV	Warning unknown
a-Alumina			10 mg/m³*	Activated aluminum oxide	N95	
Aluminum (as Al)						
-Metal and oxide dusts			10 mg/m³*		N95	
-Soluble salts and alkyls (NOC)			2 mg/m³*		N95	
-Welding fume and pyro powders			5 mg/m³*		N95	
p-Aminobenzoic acid			5 mg/m³ (AIHAWHEEL)	Aminobenzoic acid, 4-Aminobenzoic acid, PABA	(F)N95	
2-Aminoethanol				(See Ethanolamine)		
2-Aminopyridine	5		0.5	a-Aminopyridine	OV	Warning unknown
Ammonia	500	5.75	25*	Anhydrous ammonia	(F)AM	Irritation also provides warning
Ammonium chloride						
-Solids			10 mg/m³		N95	
-Liquids			10 mg/m³		AM/N95	
Ammonium perfluorooctanoate			0.01 mg/m³ -skin-		OV/N95	See Comment D, page 7
n-Amyl acetate				(See Pentyl acetate)		
sec-Amyl acetate				(See Pentyl acetate)		
n-Amyl alcohol		0.1-0.3	100 (AIHAWHEEL)	Amyl alcohol, 1-Pentanol, n-Butyl alcohol, Pentyl alcohol, Pentanol, n-Pentanol	F(OV)	
tert-Amyl methyl acetate			20	TAME	OV	
Aniline	100	0.676	2* -skin-	Aminobenzene, Phenylamine, Aniline oil	OV	
Anisidine (o-, p- isomers)						
-ortho-Anisidine	10		0.1*	o-Methoxyaniline (oil),	OV/P95	
-para-Anisidine			-skin-	p-Methoxyaniline (solid)	OV/N95	

* TLV is lower than PEL.

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Benzyl chloride	10	0.034	1	a-Chlorotoluene	(F)OV/AG	See Comment E, page 8. 3M 3510 Monitor.
Beryllium and compounds (as Be)	10 mg/m ³		0.002 mg/m³		N95	
Biphenyl	47.6	0.0093	0.2	Diphenyl, Phenylbenzene	OV/N95	
Bis(2-dimethylamino-ethyl) ether			0.05 ppm -skin-	DMAEE; Ethylamine, 2,2'-Oxybis (N,N-dimethyl)-; Niac [R] Catalyst A-99	(FOV)	
Bismuth telluride			10 mg/m³*	Bismuth sesquiteroxide	N95	
Bismuth telluride (Se-doped)			5 mg/m³		N95	
Borates, tetra, sodium salts						
–Anhydrous and pentahydrate			1 mg/m³		N95	
–Decahydrate			5 mg/m³		N95	
Boron oxide			10 mg/m³*	Anhydrous boric acid, Boric anhydride, Boric oxide	N95	
Boron tribromide			1 (ceiling)	Boron bromide	(F)AG	Warning unknown
Boron trifluoride	100	1.5	1 (ceiling)		(F)AG	Poor warning
Bromine	10	0.066	0.1		(F)OV/AG	0.2 ppm TLV-STEL. Irritation also provides warning.
Bromine pentafluoride			0.1		AG	Warning unknown
Bromochloromethane				(See Chlorobromomethane)		
Bromoform		0.447	0.5 -skin-	Tribromomethane	(F)OV	3M 3510 Monitor
1,3-Butadiene	20,000	0.455	1 (PEL)	Butadiene, Divinyl, Biethylene, Erythrene	OV	Cartridges must be replaced, per 29CFR 1910.1051
Butane		204	800	n-Butane	SA	Short OV service life
n-Butanethiol				(See Butyl mercaptan)		
2-Butanone				(See Methyl ethyl ketone)		
2-Butoxyethanol	700	0.001	20*	Butyl Cellosolve®, Ethylene glycol monobutylether	(F)OV	See Comment E, page 8
n-Butyl acetate	10,000	0.007	150	Butyl acetate, Butyl ethanoate, Acetic acid butyl ester	(F)OV	See Comment E, page 8. 3M 3510 Monitor.
sec-Butyl acetate	10,000	3-7	200	1-Methylpropylacetate	(F)OV	See Comment E, page 8. 3M 3510 Monitor.
tert-Butyl acetate	10,000	4-47	200	Acetic acid tert-butyl ester	(F)OV	3M 3510 Monitor

* TLV is lower than PEL.

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Butyl acrylate		0.003	2	2-Propenoic acid butyl ester, Butyl-2-propenoate	OV	3M 3510 Monitor
n-Butyl alcohol	8000	0.03	20*	1-Butanol, Butyl alcohol; Butyl hydroxide; Butyric alcohol; 1-Hydroxybutane; Methylolpropane; n-Propyl carbinol, n-Butanol	(F)OV	25 ppm TLV-ceiling proposed. 3M 3510 Monitor.
sec-Butyl alcohol	10,000	1	100	2-Butanol, Methyl ethyl carbinol	(F)OV	3M 3510 Monitor
tert-Butyl alcohol	8000	21.5	100	2-Methyl-2-propanol, TBA, Trimethyl-carbinol	(F)OV	3M 3510 Monitor
Butylamine	2000	0.053	5 (ceiling)-skin-	n-Butylamine, 1-Aminobutane	AM	Not specifically approved, but better service life than OV
Butylated hydroxytoluene (as inhalable aerosol and/or vapor)			2 mg/m³	BHT; DBPD; 2,6-Di-tert-butyl-p-cresol 2,6-bis(1,1-Dimethylethyl)-4-methylphenol	F(OV)/N95	
4-tert-Butylcatechol			2 mg/m³ -skin- (AIHAWHEEL)	p-tert-Butylcatechol; 4-(1,1-Dimethylethyl)-1,2-benzenediol; 4-tert-Butyl pyrocatechol; 4-tert-Butyl 1-1,2-dihydroxy benzene	(F)N95	
tert-Butyl chromate (as CrO₃)	30 mg/m ³		0.1 mg/m³ (ceiling)-skin-	Chromic acid, di-tert-Butyl ester	N95	
Butylene oxide		0.06	2 (AIHAWHEEL)	1,2-Epoxybutane; 1-Butene oxide; 1,2-Butene oxide; 1,2-Butylene oxide; Epoxy-butane; BO	OV	
n-Butyl glycidyl ether	3500		25*	BGE; 1,2-Epoxy-3-butoxy-propane	OV	Warning unknown. 3M 3510 Monitor.
n-Butyl lactate		7.06	5	Lactic acid butylester	OV	Irritation also provides warning
Butyl mercaptan	2500	0.001	0.5*	n-Butanethiol, 1-Mercaptobutane	OV	
o-sec-Butylphenol			5 -skin-	2-sec-Butylphenol	OV/P95	
p-tert-Butyltoluene	1000	5.02	1*	1-Methyl-4-tert-butylbenzene	OV	Poor warning. 3M 3510 Monitor.
Butyraldehyde		0.009	25 (AIHAWHEEL)	Butal, Butaldehyde, Butalyde, Butanol, Butanaldehyde, Butyl aldehyde, Butyral butyric aldehyde	(F)FORM	Not specifically approved, but better service life than OV
Cadmium, elemental and compounds (as Cd)	50 mg/m ³ dust 9 mg/m ³ fume		0.005 mg/m³ (PEL)		N100	0.002 mg/m ³ TLV-TWA for respirable dust
Calcium arsenate (as As)	100 mg/m ³		0.01 mg/m³ (PEL)	Tricalcium arsenate, Tricalcium o-arsenate, Cucumber dust	N100	

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Calcium carbonate			10 mg/m ³ *	Marble, Limestone	N95	
Calcium chromate			0.001 mg/m ³	Calcium chrome yellow	N95	
Calcium cyanamide			0.5 mg/m ³	Lime nitrogen, Calcium carbimide	N95	
Calcium fluoride (as F)			2.5 mg/m ³	Fluorite, Fluorspar	N95	
Calcium hydroxide			5 mg/m ³ *	Calcium hydrate, Hydrated lime, Caustic lime	N95	
Calcium oxide			2 mg/m ³ *	Quicklime, Pebble lime	N95	
Calcium silicate			10 mg/m ³ *	Calcium metasilicate, Portland cement, Wallastonite	N95	
Calcium sulfate			10 mg/m ³	Gypsum, Plaster of Paris	N95	
Camphor	33	0.051	2	2-Camphonone, Synthetic camphor, Gum camphor, Laurel camphor	(F)OV/N95	3M 3510 Monitor
Caprolactam (Inhalable aerosol and vapor)		0.064	5 mg/m ³	Aminocaproic lactam, 2-Oxohexamethyleneimine	OV/N95	
Captan inhalable fraction			5 mg/m ³	N-(Trichloromethylthio)-4-cyclohexene-1,2-dicarboximide	N95	
Carbon black			3.5 mg/m ³	Channel black, Lamp black, Furnace black, Thermal black, Acetylene black	N95	
Carbon dioxide	50,000	74,000	5,000	Carbonic acid gas, Dry ice	SA	Poor warning. Ineffective sorbents.
Carbon disulfide	500	0.096	10* -skin-	Carbon bisulfide	OV	
Carbon monoxide	1500	100,000	25*	Monoxide	SA	Poor warning. Ineffective sorbents.
Carbon tetrabromide			0.1	Tetrabromomethane	(F)OV	Warning unknown
Carbon tetrachloride	300	40.7	5* -skin-	Tetrachloromethane	(F)OV	Poor warning. 3M 3510 Monitor.
Carbonyl chloride				(See Phosgene)		
Carbonyl fluoride			2	Fluoroformyl fluoride, Carbon oxyfluoride	(F)MG	Warning unknown
Catechol			5 -skin-	Pyrocatechol	OV/N95	
Cellulose			10 mg/m ³ *	Paper fiber	N95	
Cesium fluoride			2.5 mg/m ³		N95	
Cesium hydroxide			2 mg/m ³	Cesium hydrate	N95	
Chloramphenicol			0.5 mg/m ³ (AIHAWHEEL)	Chloromycetin; Levomycetin; [R-(R*,R*)]-2,2-dichloro-N-[2-hydroxy-1-(hydroxy methyl)-2-(4-nitrophenyl)ethyl] acetamide	N95	
Chlorinated diphenyl oxide			0.5 mg/m ³	Hexachlorodiphenyl oxide	OV/P95	Warning unknown

* TLV is lower than PEL.

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Chlorine	30	0.05	0.5		(F)AG	Irritation also provides warning. PEL-1 ppm ceiling.
Chlorine dioxide	10	9.24	0.1	Chlorine oxide, Chlorine peroxide	AG	
Chlorine trifluoride	20		0.1 (ceiling)	Chlorine fluoride	MG	Warning unknown
Chloroacetaldehyde	100	0.917	0.05* -skin-	2-Chloroethanal, Chloroacetaldehyde (40% aqueous)	(F)OV	Poor warning
Chloroacetone			1 (ceiling) -skin-	Monochloroacetone, 1-Chloro-2-propanone, Chloracetone	(F)OV	Warning unknown
a-Chloroacetophenone	16	0.026	0.05	Phenacyl chloride, Chloromethyl phenyl ketone, Phenyl chloromethyl ketone (tear gas)	(F)OV/N95	Irritation also provides warning
Chloroacetyl chloride			0.05 -skin-	Chloroacetyl chloride	(F)OV/AG	Warning unknown
Chlorobenzene	2400	0.741	10*	Monochlorobenzene, Chlorobenzol, Phenyl chloride, MCB	OV	3M 3510 Monitor
o-Chlorobenzylidene malononitrile	0.25		0.05 (ceiling) -skin-	OCBM, CS	OV/N95	5X OEL maximum. Low IDLH.
Chlorobromomethane	5000	399	200	Bromochloromethane, Methylene chlorobromide, CBM, Halon™ 1011	OV	Poor warning. Short OV service life.
1-Chloro-1,1-difluoroethane			1000 (AIHAWHEEL)	HCFC-142b, Dymel® 142b, Genetron™ 142b, Chlorodifluoroethane, a-chloroethylidene fluoride (See B-Chloroprene)	SA	Short OV service life
2-Chloro-1,3-butadiene			1,000	Freon® 22	SA	Warning unknown. Ineffective sorbents.
Chlorodifluoromethane			1,000		SA	
Chlorodiphenyl (42% chlorine)	10 mg/m³		1 mg/m³ -skin-	Polychlorinated biphenyl, PCB	(F)OV/P95	See Comment D, page 7
Chlorodiphenyl (54% chlorine)	5 mg/m³		0.5 mg/m³ -skin-	Polychlorinated biphenyl, PCB	(F)OV/P95	See Comment D, page 7
1-Chloro,2,3-epoxypropane				(See Epichlorohydrin)		
2-Chloroethanol				(See Ethylene chlorohydrin)		
Chloroethylene				(See Vinyl chloride)		
Chloroform	1000	11.7	10*	Trichloromethane	OV	Poor warning. 3M 3510 Monitor.
bis-(2-Chloroisopropyl) ether			3 (AIHAWHEEL)	DCIPE, Dichloroisopropyl ether	(F)OV	Warning unknown
bis-Chloromethyl ether			0.001	Dichloromethylether, BCME, Chloro (chloromethoxy) methane, Chloromethyl ether	(F)OV	Warning unknown
Chloropentafluoroethane			1000	FC-115, Monochloropentafluoroethane	SA	Warning unknown. Short service life.

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Chloropicrin	4	1.08	0.1	Nitrotrichloromethane, Trichloronitromethane, Nitrochloroform	(F)OV	Irritation also provides warning
B-Chloroprene	400	14.9	10* -skin-	2-Chloro-1,3-Butadiene; Chlorobutadiene; beta-Chloroprene	(F)OV	Poor warning
1-Chloro-2-propanol			1 -skin-	1-Chloro-2-hydroxypropane; 1-Chloroisopropyl alcohol; sec-Propylene chlorohydrin	OV	
2-Chloro-1-propanol			1 -skin-	2-Chloropropanol; 2-Chloropropyl alcohol; 1-Hydroxy-2-chloropropane; Propylene chlorohydrin	OV	
2-Chloropropionic acid			0.1 -skin-	a-Chloropropionic acid	OV/AG	Warning unknown
o-Chlorostyrene			50	1-Chloro-2-ethenylbenzene, 2-Chlorostyrene	OV	Warning unknown. 3M 3510 Monitor.
Chlorosulfonic acid			0.1 (ceiling)	CSA, Chlorosulfuric acid	(F)AG/N95	HCl, SO ₂ hydrolysis products
2-Chloro-1,1,1,2-tetrafluoroethane			1000 (AIHAWHEEL)	Chlorotetrafluoroethane, HCFC124, HFA124, Fluorocarbon 124	SA	Short OV service life
o-Chlorotoluene		0.219	50	2-Chloro-1-methylbenzene	OV	3M 3510 Monitor
Chlorotrifluoroethylene			5 (AIHAWHEEL)	CFE, CTFE, Trifluorovinylchloride, Trifluorochloroethylene	SA	Short OV service life
Chromates of lead and zinc (as Cr)				(See Lead, Zinc chromate)		
Chromium, metal and inorganic compounds (asCr)						
–Metal and Cr III compounds			0.5 mg/m³		N95	
–Water-soluble Cr VI compounds, NOC (includes Chromic acid)	30 mg/m ³		0.05 mg/m³		N95	
–Insoluble Cr VI compounds, NOC			0.01 mg/m³		N95	
Chromyl chloride			0.025	Chromium oxychloride, Chlorochromic anhydride	AG	Warning unknown
Coal dust						
–Bituminous or lignite			0.9 mg/m³* (respirable)		N95	≥5% quartz 0.1 mg/m ³ TLV
–Anthracite			0.4 mg/m³* (respirable)		N95	≥5% quartz 0.1 mg/m ³ TLV
Coal tar pitch volatiles (as Benzene solubles)	700 mg/m ³		0.2 mg/m³		R or P95	8247, 8577 or respirators with 2076HF, 2078, 2096 or 2097 filters specifically recommended. See Comment F, page 9.

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Cobalt, elemental and inorganic compounds (as Co)	20 mg/m ³		0.02 mg/m³*		N95	
Cobalt carbonyl (as Co)			0.1 mg/m³		SA	Ineffective sorbents
Cobalt hydrocarbonyl (as Co)			0.1 mg/m³		SA	Ineffective sorbents
Coke oven emissions			0.15 mg/m³		R or P95	8247, 8577 or respirators with 2076HF, 2078, 2096 or 2097 filters specifically recommended. See Comment F, page 9.
Copper (as Cu)					N95	
-Dust and mist			1 mg/m³		N95	
-Fume			0.1 mg/m³ (PEL)		N95	
Cotton dust (raw)			0.2 mg/m³*		N95	5X PEL maximum for disposables, per OSHA cotton dust standard. If oil aerosol present, use R or P95.
Cresol (all isomers)	250	0.00005-0.0079	5 -skin-	Cresylic acid	OV/P95	
Cristobalite				(See Silica, crystalline)		
Crotonaldehyde	400	0.135	0.3 (ceiling)	B-Methylacrolein, Propylene aldehyde, Crotonaldehyde	(F)OV	
Cryolite (as F)			2.5 mg/m³	Greenland spar, Icetone	N95	
Cumene	8000	0.024	50	Isopropyl benzene, 2-Phenyl propane, Cumol	OV	3M 3510 Monitor
Cumene hydroperoxide		0.005	1 -skin- (AIHAWHEEL)	Isopropylbenzene hydroperoxide; CHP; a,a'-Dimethylbenzyl hydroperoxide; Cumyl hydroperoxide	(F)OV	
Cyanamide			2 mg/m³	Cyanogenamide, Carbodiimide	N95	
Cyanides (as CN)	50 mg/m ³		5 mg/m³ (ceiling) -skin-		SA	Poor warning
Cyanogen		231	10	Dicyan, Oxalonitrile	SA	Poor warning. Unknown sorbent effectiveness.
Cyanogen chloride		0.976	0.3 (ceiling)	CNCl	SA(F)	Poor warning. Short service life.
Cyclohexane	10,000	83.8	100	Hexahydrobenzene, Hexamethylene	(F)OV	Irritation also provides warning. 3M 3510 Monitor.

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Cyclohexanol	3500	0.068	50 -skin-	Hexalin, Hydralin, Hydroxycyclohexane, Anol, Hexahydrophenol, Cyclohexyl alcohol	OV	See Comment E, page 8. 3M 3510 Monitor.
Cyclohexanone	5000	0.019	20 -skin-	Pimelic ketone, Cyclohexyl ketone	OV	3M 3510 Monitor
Cyclohexene	10,000	0.363	300	Benzene tetrahydride	OV	3M 3510 Monitor
Cyclohexylamine		2.66	10	Hexahydroaniline, Aminocyclohexane	(F)OV	
Cyclonite			0.5 mg/m ³ -skin-	RDX; sym-Trimethylene trinitramine; Hexahydro-1,3,5-trinitro-sym-triazine	N95	
Cyclopentadiene	2000	3.8	75	1,3-Cyclopentadiene	OV	
Cyclopentane			600	Pentamethylene	SA	Warning unknown. Short OV service life.
Decaborane	20	0.06	0.05 -skin-		SA	Poor warning. Unknown sorbent effectiveness.
Decabromodiphenyl oxide			5 mg/m ³ (AIHAWHEEL)	DBDPO, Decabromodiphenyl ether, bis-(pentabromophenyl) ether	N95	
1-Decene		7	100 (AIHAWHEEL)	Decylene, alpha-decene	OV	
Diacetone alcohol	2100	0.891	50	Diacetone, 4-Hydroxy-4-methyl-2-pentanone, 2-Methyl-2-pentanol-4-one	(F)OV	3M 3510 Monitor
Diallylamine		2-9	1 -skin- (AIHAWHEEL)	N-2-propenyl-2-propen-1-amine, Di-2-propenylamine	OV	Poor warning
1,2-Diaminoethane				(See Ethylenediamine)		
Diatomaceous earth (uncalcined)				(See Silica)		
Diazomethane	2		0.2	Azimethylene, Diazirine	SA	Warning unknown. Unknown sorbent effectiveness.
Diborane	40	1.8-3.5	0.1	Boroethane	SA	Poor warning. Unknown sorbent effectiveness.
Dibromochloropropane			1 ppb (PEL)	1-Chloro-2,3-dibromopropane; DBCP; 1,2-Dibromo-3-chloropropane	SA(F)	Warning unknown. OSHA requires SA(F); no change schedule allowed.
1,2-Dibromoethane				(See Ethylene dibromide)		
Dibutylamine		0.1	5 (ceiling) -skin- (AIHAWHEEL)	1-Butanamine, n-Butyl, Di-n-butylamine, DNBA	F(OV)	See Comment E, page 8
2-N-Dibutylaminoethanol			0.5 -skin-	Dibutylaminoethanol; N,N-dibutyl-N-(2-hydroxyethyl) amine	(F)OV	Warning unknown

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Dibutyl phenyl phosphate			0.3 -skin-	DBPP	R or P95	OV/P95 may be preferable if heat involved
Dibutyl phosphate	125		1	Dibutyl acid-o-phosphate, Di-n-butyl hydrogen phosphate, Dibutyl phosphoric acid	OV/P95	
Dibutyl phthalate	9300 mg/m ³		5 mg/m³	DBP; Dibutyl; 1,2-Benzene-dicarboxylate	OV/P95	See Comment D, page 7
Dichloroacetylene			0.1 (ceiling)	Dichloroethyne	SA(F)	Warning unknown. Short OV service life.
o-Dichlorobenzene	1000	0.072	25	1,2-Dichlorobenzene; o-Dichloro-benzol	(F)OV	See Comment E, page 8. PEL-50 ppm ceiling. 3M 3510 Monitor.
p-Dichlorobenzene	1000	0.048	10*	1,4-Dichlorobenzene; Dichloride; PDCB	(F)OV/N95	3M 3510 Monitor
1,4-Dichloro-2-butene			0.005 -skin-	2-Butylenedichloride; DCB; 1,4-DCB; Dichlorobutene	(F)OV	Warning unknown
Dichlorodifluoromethane	50,000		1000	Refrigerant 12, Freon® 12	SA	Warning unknown. Short OV service life.
1,3-Dichloro-5,5-dimethylhydantoin		0.01	0.2 mg/m³	Halane, Dactin	OV/N95	
1,1-Dichloroethane	4000	255	100	Ethylidene chloride	OV	Poor warning
1,2-Dichloroethane				(See Ethylene dichloride)		
1,1-Dichloroethylene				(See Vinylidene chloride)		
1,2-Dichloroethylene	4000	19.1	200	Acetylene dichloride, Dioform	OV	
Dichloroethyl ether	250	0.049	5 -skin-	bis-(2-Chloroethyl) ether; 2,2'-Dichlorodiethyl ether	(F)OV	PEL-15 ppm ceiling
Dichlorofluoromethane	50,000		10*	Refrigerant 21, Freon® 21, Dichloromonofluoromethane	SA	Warning unknown. Short OV service life.
1,1-Dichloro-1-fluoroethane			500 (AIHAWHEEL)	HCFC141b, HFA141b, Fluorocarbon 141b	SA	Short OV service life
Dichloromethane				(See Methylene chloride)		
1,1-Dichloro-1-nitroethane	150		2		OV	Warning unknown. PEL-10 ppm ceiling.
1,2-Dichloropropane				(See Propylene dichloride)		
1,3-Dichloropropene			1 -skin-	1,3-Dichloropropylene	(F)OV	Warning unknown
2,2-Dichloropropionic acid			5 mg/m³	Dalapon™	(F)OV/N95	Warning unknown
Dichlorotetrafluoroethane	50,000		1000	Freon® 114, Refrigerant 114, Halon™ 242, FC-114	SA	Warning unknown. Short OV service life.

* TLV is lower than PEL.

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Dicyclopentadiene		0.03	5		OV/N95	
Dicyclopentadienyl iron			10 mg/m³*	bis-Cyclopentadienyl iron	N95	
Diesel Fuel (total hydrocarbons, vapor and aerosol)			100 mg/m³ -skin-	Astral oil, Gas oil, Coal oil, Fuel oil, Home heating oil, Marine diesel fuel	OV/P95	
Diethanolamine		0.025	0.46 -skin-	DEA, di-(2-Hydroxyethyl) amine	OV	See Comment E, page 8
Diethylamine	2000	0.186	5* -skin-		(F)AM (F)OV	AM not specifically approved
Diethylaminoethanol	500	0.034	10 -skin-	2-Diethylaminoethyl alcohol; N,N-Diethylethanolamine	OV	
Diethylene glycol			10 mg/m³ (AIHAWHEEL)	DEG; Diglycol; 2,2'-Dihydroxy-diethyl ether	R or P95	See Comments D and G, pages 7 & 9
Diethylene glycol monoethyl ether		0.708	25 (AIHAWHEEL)	2-(2-Ethoxyethoxy) ethanol, DiGGE, Diethylene glycol ethyl ether, Glycol ether DE, Carbitol, Dioxitol	OV	
Diethylene triamine		9.3	1 -skin-		(F)OV	Poor warning
Diethyl ether				(See Ethyl ether)		
Di-2-ethylhexyl phthalate				(See Di-sec-octyl phthalate)		
Diethyl ketone		0.316	200	Metacetone, Propione, 3-Pentanone, Ethyl propionyl	OV	
Diethyl phthalate			5 mg/m³	Ethylphthalate, DEP	R or P95	
Difluorodibromomethane	2500		100	Dibromodifluoromethane, Freon® 12B2, DFBM	OV	Warning unknown
1,1-Difluoroethane			1000 (AIHAWHEEL)	HFC-152a, Freon® 152a, Dymel® 152a, Genetron™ 152a, Ethylidene fluoride	SA	Ineffective sorbents
Difluoromethane			1000 (AIHAWHEEL)	Refrigerant 32; R32; Hydrofluorocarbon 32	SA	Warning unknown. Ineffective sorbents.
Diglycidyl ether	25	4.61	0.1	di-(Epoxypropyl) ether; bis-(2,3-Epoxypropyl)-ether; 2-Epoxypropyl ether; Diallyl ether dioxide; DGE	(F)OV	Poor warning
Dihydroxybenzene				(See Hydroquinone)		
Diisobutylene			75 (AIHAWHEEL)	Diisobutene	OV	
Diisobutyl ketone	2000	0.339	25*	2,6-Dimethyl-4-heptanone; sym-Diisopropylacetone; Isovalerone; Valerone	(F)OV	See Comment E, page 8. 3M 3510 Monitor.
Diisopropylamine	1000	0.398	5 -skin-		(F)OV	
Dimethoxymethane				(See Methylal)		
Dimethyl acetamide	400	47.9	10 -skin-	N,N-Dimethyl acetamide; DMAC	OV	Poor warning

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Dimethylamine	2000	0.081	5*	Anhydrous dimethylamine	AM	AM not specifically approved. Short OV service life.
Dimethylaminobenzene				(See Xylidine)		
Dimethylaniline	100	0.219	5 -skin-	N,N-Dimethylaniline	OV	
Dimethyldichlorosilane			2 (ceiling) (AIHAWHEEL)	Dichlorodimethylsilane	OV/AG	Warning unknown
Dimethylethoxysilane			0.5	Ethoxydimethyl silane	SA(F)	Unknown sorbent effectiveness
Dimethylbenzene				(See Xylene)		
Dimethyl ether		0.3-9.0	1000 (AIHAWHEEL)	Methyl ether, Wood ether	SA	Very short OV service life
Dimethyl formamide	3500	100	10 -skin-	N,N-Dimethyl formamide; DMF	OV	Poor warning
2,6-Dimethyl-4-heptanone				(See Diisobutyl ketone)		
1,1-Dimethylhydrazine	50	8.79	0.01 -skin-	unsym-Dimethylhydrazine, UDMH	SA(F)	Poor warning. Unknown sorbent effectiveness.
Dimethylphthalate	9300 mg/m ³		5 mg/m ³	DMP	OV/P95	See Comment D, page 7
1,1-Dimethylpropyl acetate				(See Pentyl acetate)		
Dimethyl sulfoxide			250 -skin-	DMSO, Methylsulfoxide	OV	
Dimethylsulfate	10		0.1* -skin-	Methyl sulfate	(F)OV	Poor warning
Dimethyl terephthalate			5 mg/m ³ (total dust) (AIHAWHEEL)		OV/N95	
Dinitrobenzene	29		0.15* -skin-	o-Dinitrobenzene, 1,2-Dinitrobenzene; m-Dinitrobenzene; 1,3-Dinitrobenzene; p-Dinitrobenzene, 1,4-Dinitrobenzene	OV/N95	
3,5-Dinitro-o-toluamide			5 mg/m ³	Dinitolmide	N95	
Dinitrotoluene	200 mg/m ³		0.2 mg/m ³ -skin-	DNT	OV/N95	See Comment D, page 7
Dioxane	2000	7.78	20* -skin-	Diethylene dioxide; Diethylene ether; p-Dioxane; 1,4-Dioxane	OV	3M 3510 Monitor
1,3-Dioxalane			20	1,3-Dioxacyclopentane; 1,3-Dioxolan; Dioxolane; 1,3-Dioxole, dihydroethylene glycol formal; Formal glycol; Glycolformal; Glycol methylene ether	OV	
Diphenyl				(See Biphenyl)		

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Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Diphenylamine		0.022	10 mg/m ³	DPA, N-phenylaniline	N95	OV/N95 may be preferable when odor is a problem
4,4-Diphenylmethane diisocyanate				(See Methylenebisphenyl isocyanate)		
Dipropylene glycol methyl ether		1000	100 -skin-	Dipropylene glycol monomethyl ether, Dowanol™ 50B	OV	Poor warning
Dipropyl ketone			50	Butyrane, 4-Heptanone	OV	Warning unknown
Di-sec-octyl phthalate			5 mg/m ³	DOP, bis-(2-Ethylhexyl)phthalate, Di-2-ethylhexyl phthalate, DEHP	R or P95	
Divinyl benzene			10	DVB, Vinylstyrene	(F)OV	Warning unknown
Dowtherm™ Q (as inhalable aerosol and/or vapor)			1 (AIHAWHEEL)	1,1-Dipheylethane with ethylated benzenes	OV/P95	
Emery			10 mg/m ³ *	Corundum	N95	
Enflurane			75	2-Chloro-1,1,2-trifluoroethyl-difluoromethyl ether; Ethrane	SA	Warning unknown. Short OV service life. 3M 3510 Monitor.
Epichlorohydrin	250	0.934	0.5* -skin-	1-Chloro-2,3-epoxy-propane; 2-Chloropropylene oxide; g-Chloropropylene oxide	(F)OV	Poor warning. 3M 3510 Monitor.
1,2-Epoxypropane				(See Propylene oxide)		
2,3-Epoxy-1-propanol				(See Glycidol)		
Erythromycin			3 mg/m ³ (AIHAWHEEL)	Dotycin, Erycin, Ericynum, E-Mycin™, Pentadecanoic acid	N95	
Ethanolamine	1000	2.59	3	Ethylolamine, Monoethanolamine, B-Aminoethyl alcohol, 2-Aminoethanol, 2-Hydroxyethylamine	OV	
2-Ethoxyethanol	6000	1.22	5* -skin-	Ethylene glycol monoethyl ether, Glycol monoethyl ether, Cellosolve® solvent	OV	3M 3510 Monitor
2-Ethoxyethyl acetate	2500	0.182	5* -skin-	Cellosolve® acetate, Ethylene glycol monoethyl ether acetate	OV	3M 3510 Monitor
Ethyl acetate	10,000	0.61	400	Acetic ester, Acetic ether, Ethyl ethanoate	(F)OV	3M 3510 Monitor
Ethyl acrylate	2000	0.0009	5* -skin-	Acrylic acid, Ethyl ester	(F)OV	3M 3510 Monitor
Ethyl alcohol	15,000	0.136	1000	Ethanol	OV	Short OV service life at 10X OEL
Ethylamine	4000	0.324	5* -skin-	Anhydrous ethylamine, Aminoethane, Monoethylamine	(F)AM	AM not specifically approved. Short OV service life.
Ethyl amyl ketone	3000	6	25	EAK, 5-Methyl-3-heptanone	(F)OV	

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Ethyl benzene	2000	2.3	100	Phenylethane, Ethylbenzol	OV	See Comment E, page 8. 3M 3510 Monitor.
Ethyl bromide	3500	3.09	5* -skin-	Bromoethane	SA	Short OV service life
Ethyl butyl ketone	3000	0.1-10	50	3-Heptanone	OV	See Comment E, page 8
Ethyl chloride	20,000	4.07	100 -skin-	Chloroethane, Monochloroethane, Hydrochloric ether	SA	Very short OV service life
Ethyl cyanoacrylate			0.2	2-Cyanoacrylic acid, ethyl ester; 2-Cyano-2 propenoic acid, ethyl ester; ECA; Ethyl alpha-cyanoacrylate; Ethyl 2-cyanoacrylate; Ethyl 2-cyano-2-propenoate	OV	Warning unknown
Ethyl tert-butyl ether			5	tert-Butyl ethyl ether; 1,1-Dimethylethyl ether; ETBE; 2-Ethoxy-2-methylpropane; Ethyl tert-butyl oxide; Ethyl 1,1-dimethylethyl ether	OV	
Ethylene chlorohydrin	10	0.402	1* (ceiling) -skin-	2-Chloroethanol, 2-Chloroethyl alcohol	OV	3M 3510 Monitor
Ethylenediamine	2000	4.27	10	1,2-Diaminoethane; 1,2-Ethanediamine	(F)OV	
Ethylene dibromide	400	9.84	20 (PEL) -skin-	1,2-Dibromoethane	(F)OV	
Ethylene dichloride	1000	11.2	10*	Ethylene chloride; 1,2-Dichloroethane	OV	Poor warning. 3M 3510 Monitor.
Ethylene glycol, aerosol		60.3 mg/m ³	100 mg/m ³ (ceiling)	Ethylene alcohol; Glycol; 1,2-Ethanediol	OV/P95	See Comments D and G, pages 7 & 9
Ethylene glycol dinitrate	82		0.05* -skin-	Glycol dinitrate, Nitroglycol	OV	Warning unknown. PEL-0.2 ppm ceiling.
Ethylene glycol methyl ether acetate				(See 2-Methoxyethyl acetate)		
Ethyleneimine	100	1.5	0.5 -skin-	Ethyleimine, Dimethylenimine, Dihydroazirine, Azirane, Aziridine, Aminoethylene	SA(F)	Poor warning. OSHA requires SA(F); see 29 CFR 1910.1003.
Ethylene oxide	800	851	1	Dimethylene oxide; 1,2-Epoxy ethane; Oxirane	SA(F)	Poor warning. OSHA requires SA(F); no change schedule allowed. 3M 3550 Monitor.
Ethyl ether	19,000	2.29	400	Diethyl ether, Ethyl oxide, Ether	OV	Short service life. 3M 3530 Monitor.
Ethyl formate	8000	18.6	100	Ethyl methanoate, Formic acid ethyl ester	(F)OV	Short service life

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
2-Ethylhexanoic acid (as inhalable aerosol and vapor)			5 mg/m³	Butylethylacetic acid; 2-Butylbutanoic acid; 2-Ethylcaproic acid; 2-Ethylhexoic acid; Ethylhexoic acid	OV/N95	
Ethylidene chloride				(See 1,1-Dichloroethane)		
Ethylidene norbornene		0.074	5 (ceiling)	ENB	(F)OV	
Ethyl mercaptan	2500	0.001	0.5*	Ethanethiol, Ethyl sulfhydrate	OV	
N-Ethylmorpholine	2000	0.275	5* -skin-	4-Ethylmorpholine	(F)OV	
Ethyl silicate	1000	3.6	10*	Tetraethyl silicate, Ethyl orthosilicate, Tetraethoxysilane	OV	
Ferric/Ferrous salts, soluble				(See Iron salts)		
Ferrovandium, dust			1 mg/m³		N95	
Fibrous glass, dust				(See Synthetic vitreous fibers - Continuous filament glass fibers)		
Flour dust (as inhalable particles)			0.5 mg/m³		N95	
Fluorides (as F)	500 mg/m ³		2.5 mg/m³	Synonyms vary depending upon specific compound	N95	
Fluorine	25	0.126	0.1 (PEL)		SA(F)	Poor warning. Unknown reaction products with sorbent.
Fluorotrichloromethane				(See Trichlorofluoromethane)		
Formaldehyde	30	0.871	0.3* (ceiling)	Methylene oxide, Formalin	(F)FORM	Irritation also provides warning. 3M 3720 Monitor.
Formamide		80	10* -skin-	Methanamide	OV	Poor warning
Formic acid	30	28.2	5	Hydrogencarboxylic acid, Methanoic acid	(F)OV	Poor warning. 6X OEL maximum. Low IDLH.
Furfural	250	0.058	2* -skin-	2-Furaldehyde, Furfuraldehyde, Fural, 2-Furancarboxaldehyde	(F)OV	3M 3510 Monitor
Furfuryl alcohol	250	7.83	10* -skin-	2-Hydroxymethylfuran, 2-Furyl-methanol	(F)OV	See Comment E, page 8
Gasoline		0.3	300	Petrol	(F)OV	
Germanium tetrahydride			0.2	Germane, Germanium hydride	SA(F)	Warning unknown. Unknown sorbent effectiveness.
Glass, fibrous or dust				(See Synthetic vitreous fibers)		
Glutaraldehyde		0.038	0.05 (ceiling)	1,5-Pentanedial	(F)OV	See Comment E, page 8
Glycerin, mist			10 mg/m³*	Glycerol	R or P95	

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Glycidol	500		2*	2-Hydroxymethyloxiran; Hydroxymethyl ethylene oxide; Epoxypropyl alcohol; 3-Hydroxypropylene oxide; 2,3-Epoxy-1-propanol	OV	Warning unknown
Glycidyl methacrylate			0.5 (AIHAWHEEL)-skin-	GMA	OV	
Glycol monoethyl ether				(See 2-Ethoxyethanol)		
Glyoxal (as inhalable aerosol and/or vapor)			0.1 mg/m³	Ethanedial, Biformyl, Diformyl, Oxaldehyde, 1,2-Ethanedione	(F)OV/N95	Short OV service for vapor at 10X OEL
Grain dust (oat, wheat, barley)			4 mg/m^{3*} (respirable)		N95	
Graphite (natural)			2.5 mg/m^{3*} (respirable)	Plumbago, Potelot, Corbo minerals, Black lead, Silver lead	N95	
Graphite (synthetic)			2 mg/m^{3*} (respirable)		N95	
Gypsum				(See Calcium sulfate)		
Hafnium and compounds (as Hf)			0.5 mg/m³		N95	
Halothane		33	50	2-Bromo-2-chloro-1,1,1-trifluoroethane	OV	3M 3510 Monitor
Heptane	5000	9.77	400*	Normal heptane, n-Heptane	OV	3M 3510 Monitor
2-Heptanone				(See Methyl n-amyl ketone)		
3-Heptanone				(See Ethyl butyl ketone)		
Hexachlorobenzene		0.463 mg/m ³	0.002 mg/m³ -skin-	Perchlorobenzene	N95	
Hexachlorobutadiene			0.02 -skin-	Hexachloro-1,3-butadiene; perchlorobutadiene	(F)OV	Warning unknown
Hexachlorocyclopentadiene		0.03	0.01		(F)OV	Poor warning
Hexachloroethane	300	0.15	1 -skin-	Perchloroethane	OV/N95	
Hexachloronaphthalene	2 mg/m ³		0.2 mg/m³ -skin-	Halowax™ 1014	OV/N95	See Comment D, page 7
1,4-Hexadiene			10 (AIHAWHEEL)		OV	Warning unknown
Hexafluoroacetone			0.1 -skin-	1,1,1,3,3,3-Hexafluoro-2-propanone	SA	Warning unknown. Short OV service life.
1,1,1,3,3,3-Hexafluoropropane			1000 (AIHAWHEEL)	HFC-236 fa; FC-236 fa; hydrofluorocarbon 236 fa; FE-13	SA	Ineffective sorbents

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Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Hexamethylenediamine		~0.0032 mg/m ³	5 mg/m ³ (AIHAWHEEL)	1,6-Hexanediamine; 1,6-Diaminohexane; HMDA; HMD	OV/N95	See Comment D, page 7
Hexamethylene diisocyanate		0.01	0.005	HDI; HMDI	OV/N95	Poor warning
Hexane (n-Hexane)	5000	21.9	50* -skin-	Hexyl hydride, Normal hexane	OV	3M 3510 Monitor
Hexane (other isomers)		65-248	500		OV	3M 3510 Monitor
Hexanediol diacrylate			1 mg/m ³ (AIHAWHEEL)	HDODA; Propenoic acid, 1,6-hexanediol ester	OV/P95	See Comment D, page 7
2-Hexanone				(See Methyl n-butyl ketone)		
1-Hexene			50	Butyl ethylene; Hexene; Hex-1-ene; Hexene-n-1; Hexylene	OV	Warning unknown
Hexone				(See Methyl isobutyl ketone)		
sec-Hexyl acetate	4000	0.219	50	1,3-Dimethylbutyl acetate; Methylamyl acetate; Methylisoamyl acetate; Methylisobutyl carbinol	(F)OV	See Comment E, page 8
Hexylene glycol		49.9	25 (ceiling)	4-Methyl-2,4-pentanediol	(F)OV	Irritation also provides warning
HFE-7100			750 (AIHAWHEEL)	Mixture of 1-Methoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane (40%) and 1-Methoxy-2-Trifluoromethyl-1,1,2,3,3,3-hexafluoropropane (60%); Mixture of 1-Methoxyperfluorobutane (40%) and 1-Methoxyperfluoroisobutane (60%)	OV	Warning unknown
Hydrazine	80	3.6	0.01* -skin-	Anhydrous hydrazine	SA(F)	Poor warning
Hydrogenated terphenyls			0.5		R or P95	
Hydrogen bromide	50	1.99	3 (ceiling)	Hydrobromic acid, HBr	AG	Not specifically approved for HBr
Hydrogen chloride	100	0.77	2 (ceiling)	Hydrochloric acid, HCl, Muriatic acid	AG	Irritation also provides warning
Hydrogen cyanide	50	0.603	4.7* (ceiling) -skin-	Hydrocyanic acid, Prussic acid	SA(F)	10X OEL maximum. Low IDLH.
Hydrogen fluoride	30	0.036	3 (ceiling)	Anhydrofluoric acid, HF	(F)HF	10X OEL maximum. Low IDLH.
Hydrogen peroxide	75		1	Peroxide, Hydrogen dioxide	SA(F)	Warning unknown. Unknown sorbent effectiveness.
Hydrogen selenide (as Se)	2	0.3	0.05	Selenium hydride	(F)MG	Poor warning

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Isooctyl alcohol			50 -skin-	Isooctanol	OV	Warning unknown
Isophorone	800	0.631	5* (ceiling)	3,5,5-Trimethyl-2-cyclohexene-1-one	OV	See Comment E, page 8. 3M 3510 Monitor.
Isophorone diisocyanate			0.005	IPDI	OV/N95	Warning unknown
Isophthalic acid			5 mg/m ³ (respirable) (AIHAWHEEL)	1,3-Dicarboxylic acid; m-Phthalic acid; IA; IPA	N95	
Isoprene			50 (AIHAWHEEL)	2-Methyl-1,3-butadiene	OV	Warning unknown
Isopropoxyethanol		0.738	25 -skin-	IPE, Isopropyl glycol, Ethylene glycol monoisopropyl ether, Isopropyl Cellosolve®	OV	
Isopropyl acetate	16,000	0.05-4.1	100	Isopropyl ester of acetic acid, sec-Propyl acetate	(F)OV	3M 3510 Monitor
Isopropyl alcohol	12,000	22	200	Isopropanol, IPA, 2-Propanol, sec-Propyl alcohol	(F)OV	Irritation also provides warning. 3M 3530 Monitor.
Isopropylamine	4000	0.6	5	Monoisopropylamine, 2-Aminopropane	(F)AM (F)OV	AM not specifically approved
N-Isopropylaniline			2 -skin-	o-Isopropylaniline, o-Amino-isopropylbenzene	OV	Warning unknown
Isopropyl ether	10,000	0.055	250*	Diisopropyl ether	OV	
Isopropyl glycidyl ether	1000	297	50	Isopropoxymethyl-oxiran; 1,2-Epoxy-3-isopropoxy-propane; Isopropyl epoxypropyl ether; IGE	(F)OV	Poor warning
Kaolin			2 mg/m ³ * (respirable)	China clay, Aluminum silicate	N95	
Ketene			0.5	Carbomethene, Ethenone	SA(F)	Warning unknown. Ineffective sorbents.
Kerosene (Total hydrocarbon vapor)			200 -skin-	Deobase, Kerosine, Diesel No. 1	OV/P95	When aerosols present, add a particulate prefilter.
Lacquer thinner				(See specific ingredients)		
Lead, elemental and inorganic compounds (as Pb)	700 mg/m ³		0.05 mg/m ³		N100	
Lead arsenate (as As)			0.01 mg/m ³ (PEL)		N100	
Lead chromate (as Cr)			0.012 mg/m ³ *	Chrome orange, Red lead chromate	N100	
Limestone				(See Calcium carbonate)		

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
d-Limonene		0.437	30 (AIHAWHEEL)	1-methyl-4(1-methylethenyl)cyclohexene; 4-isopropyl-1-methylcyclohexene; p-mentha-1,8-diene; Cinene; Cajeputene	OV	
Lithium fluoride (as F)			2.5 mg/m³		N95	
Lithium hydride	55 mg/m ³		0.025 mg/m³		N95	
Lithium hydroxide			1 mg/m³ (ceiling) (AIHAWHEEL)	Lithium hydroxide monohydrate	N95	
Lithium oxide			1 mg/m³ (ceiling) (AIHAWHEEL)	Dilithium oxide, Lithium monoxide	N95	
LPG	19,000		1000	Liquefied petroleum gas, Bottled gas	SA	Warning unknown. Mixture with compounds with short OV service life.
Magnesite			10 mg/m³*	Magnesium carbonate	N95	
Magnesium oxide fume			10 mg/m³*	Magnesia fume	N95	
Maleic anhydride		0.318	0.1		(F)OV/N95	Poor warning
Manganese, elemental and inorganic compounds (as Mn)			0.2 mg/m³*		N95	
Manganese cyclopentadienyl tricarbonyl			0.1 mg/m³ -skin-	MCT	SA	Properties of vapor unknown
Marble				(See Calcium carbonate)		
Melamine			10 mg/m³ (inhalable) (AIHAWHEEL)	1,3,5-Triazine-2,4,6-triamine; 2,4,6-Triamino-1,3,5-Triazine, Cyanuramide	N95	
			5 mg/m³ (respirable) (AIHAWHEEL)		N95	
2-Mercaptobenzothiazole		12 mg/m ³	5 mg/m³ -skin- (AIHAWHEEL)	Mercaptobenzothiazole; 2(3H)-Benzothiazolyl mercaptan; Benzothiazole-2-thione	N95	
Mercaptoethanol		0.12-0.64	0.2 -skin- (AIHAWHEEL)	2-Mercaptoethanol, 2ME, 1-Hydroxy-2-mercaptoethane, 2-Hydroxy-1-ethanethiol, 2-Hydroxyethylmercaptan, 2-Thioethanol, Thioethyleneglycol, Thioglycol	OV	Poor warning

* TLV is lower than PEL.

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Mercury (as Hg)						
–Vapor	28 mg/m ³		0.025 mg/m³*	Quicksilver, Hg	Hg	
–Alkyl compounds	10 mg/m ³		0.01 mg/m³		SA	
–Aryl compounds	28 mg/m ³		0.1 mg/m³		N95	Dust with essentially no vapor pressure only
–Inorganic compounds	28 mg/m ³		0.025 mg/m³*		N95	Dust with essentially no vapor pressure only. Hg/N95 for volatile liquids.
Mesityl oxide	5000	0.056	15*	Isobutenyl methyl ketone, Methyl isobutenyl ketone, Isopropylidene acetone	(F)OV	3M 3510 Monitor
Methacrylic acid			20	a-Methacrylic acid	(F)OV	Warning unknown
Methanethiol				(See Methyl mercaptan)		
2-Methoxyethanol	2000	0.11	5*	Ethylene glycol monomethyl ether, Methyl Cellosolve®	OV	3M 3510 Monitor
			-skin-			
2-Methoxyethyl acetate	4000	1.07	5*	Ethylene glycol methyl ether acetate, Ethylene glycol monomethyl ether acetate, Methyl Cellosolve® acetate	OV	3M 3510 Monitor
			-skin-			
4-Methoxyphenol			5 mg/m³	p-Methoxyphenol, Hydroquinone monomethyl ether	N95	
3-Methoxypropyl amine		2.7	5	1-Propanimine, 3-Methoxy	(F)OV (F)AM	Irritation also provides warning. AM not specifically approved.
			(AIHAWHEEL)			
Methyl acetate	10,000	6.17	200	Acetic acid, methyl ester; Methyl acetic ester; Methyl ethanoate	OV	
Methyl acetylene	15,000		1000	Propyne, Allylene	SA	Warning unknown. Very short OV service life.
Methyl acetylene propadiene mixture	15,000	100	1000	MAPP gas, Methyl acetylene-allene mixture, Propyne-allene mixture	SA	Very short OV service life
Methyl acrylate	1000	0.263	2	Methyl propenoate	(F)OV	3M 3510 Monitor
			-skin-			
Methylacrylonitrile		6.8	1	2-Methyl-2-propenenitrile, Isoprene cyanide	SA	Poor warning
			-skin-			
Methylal	15,000		1000	Dimethoxymethane, Methyl formal, Formal, Dimethylacetal formaldehyde	SA	Warning unknown

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Methyl alcohol	25,000	141	200 -skin-	Methanol, Wood alcohol, Carbinol	SA	Very short OV service life
Methylamine	100	0.019	5*	Monomethylamine	(F)AM	
Methyl amyl alcohol	2000	1.1	25 -skin-	Methyl isobutyl carbinol	OV	
Methyl n-amyl ketone	4000	0.141	50*	n-Amyl methyl ketone, 2-Heptanone	OV	See Comment E, page 8
Methylaniline	100	1.74	0.5* -skin-	Monomethyl aniline, MA, N-Methyl aniline	OV	Poor warning
Methyl bromide	2000		1* -skin-	Bromomethane	SA(F)	Warning unknown. Very short OV service life.
2-Methylbutyl acetate				(See Pentyl acetate)		
Methyl n-butyl ketone	5000	0.166	5* -skin-	2-Hexanone, MBK	OV	3M 3510 Monitor
Methyl Cellosolve®				(See 2-Methoxyethanol)		
Methyl Cellosolve® acetate				(See 2-Methoxyethyl acetate)		
Methyl chloride	10,000	10.2	50* -skin-	Chloromethane	SA	Very short OV service life
Methyl chloroform	1000	22.4	350	1,1,1-Trichloroethane	OV	3M 3510 Monitor
Methyl 2-cyanoacrylate		2.16	0.2	Mecrylate	(F)OV	Poor warning
Methylcyclohexane	10,000	500-630	400*	Cyclohexylmethane, Hexahydrotoluene	OV	Poor warning
Methylcyclohexanol	10,000	490	50*	Hexahydrocresols	OV	Poor warning
o-Methylcyclohexanone	2500		50* -skin-	2-Methylcyclohexanone	(F)OV	Irritation also provides warning
2-Methylcyclopentadienyl manganese tricarbonyl (as Mn)			0.2 mg/m³ -skin-		OV/N95	SA preferable if heat involved
Methylenebisphenyl isocyanate	9.7	0.384	0.005*	MDI; 4,4'-Diphenylmethane diisocyanate; Methylene-bis-(4-phenyl isocyanate)	OV/N95	Poor warning
Methylene chloride	5000	0.912	25 (PEL)	Dichloromethane, Methylene dichloride	SA(F)	OSHA requires SA(F); no change schedule allowed. Short OV service life. 3M 3530 Monitor.
4,4'-Methylene-bis-(2-chloroaniline)			0.01 -skin-	MOCA; DACPM; 4,4'-Methylene bis-(2-chlorobenzamine)	OV	Warning unknown
Methylene-bis-(4-cyclohexylisocyanate)			0.005		OV/N95	Warning unknown

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
4,4'-Methylene dianiline			0.01 (PEL) -skin-	4,4'-Diaminodiphenylmethane; MDA	N100	Warning unknown. Use OV/N100 if heat is involved. See 29 CFR 1910.1050.
Methyl ethyl ketone	3000	0.27	200	MEK, 2-Butanone	(F)OV	3M 3510 Monitor
Methyl ethyl ketone peroxide			0.2 (ceiling)	MEKP	(F)OV	Warning unknown
Methyl ethyl ketoxime			10 (AIHAWHEEL)	2-Butanone oxime, MEKO	OV	Warning unknown
Methyl formate	5000	93.3	100	Methyl methanoate, Formic acid, Methyl ester	SA	Short OV service life
5-Methyl-3-heptanone				(See Ethyl amyl ketone)		
Methyl hydrazine	50	1.71	0.01 -skin-	Monomethyl hydrazine	SA(F)	Poor warning. Unknown sorbent effectiveness.
Methyl iodide	800		2 -skin-	Iodomethane	SA(F)	Warning unknown. Short OV service life.
Methyl isoamyl ketone		0.042	50*	5-Methyl-2-hexanone, 2-Methyl-5-hexanone, MIAK	(F)OV	
Methyl isobutyl carbinol				(See Methyl amyl alcohol)		
Methyl isobutyl ketone	3000	0.121	50*	MIBK, Hexone	(F)OV	3M 3510 Monitor
Methyl isocyanate	20	2.1	0.02 -skin-	Isocyanic acid, methyl ester	SA	Poor warning. Unknown sorbent effectiveness.
Methyl isopropyl ketone		4.47	200	MIPK, 3-Methyl-2-butanone	(F)OV	
Methyl mercaptan	400	0.001	0.5*	Methanethiol	OV	Very short OV service life
Methyl methacrylate	4000	0.085	50	Methacrylic acid, methyl ester	OV	3M 3510 Monitor
Methyl propyl ketone	5000	1.55	200	MPK, 2-Pentanone, Ethyl acetone	(F)OV	3M 3510 Monitor
n-Methyl-2-pyrrolidone			10 -skin- (AIHAWHEEL)	NMP; 1-Methyl-2-pyrrolidone; m-Pyrol; n-Methyl pyrrolidone	OV	Warning unknown
Methyl silicate			1	Tetramethoxy silane	(F)OV	Warning unknown
a-Methyl styrene	5000	0.003	50	1-Methyl-1-phenyl-ethylene, AMS	OV	See Comment E, page 8. PEL-100 ppm ceiling.
Methyl tert-butyl ether		0.053	50	2-Methoxy-2-methyl-propane; tert-Butyl methyl ether; MTBE; 2,2-MMOP	OV	3M 3510 Monitor
Methyltrichlorosilane			1 (ceiling) (AIHAWHEEL)	Trichloromethylsilane	(F)AG/N95	Irritation provides warning

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Methyl vinyl ketone		0.2	0.2 (ceiling)-skin-	Acetyl ethylene; 3-Buten-2-one; 3-Butene-2-one; Butenone; d(3)-2-Butenone; Methylene acetone; Methyl vinyl acetone; g-Oxo-a-Butylene	OV	
Mica (less than 1% quartz)			3 mg/m³* (respirable)		N95	
Mineral spirits				(See Stoddard solvent)		
Mineral (rock), wool fiber				(See Synthetic vitreous fibers–Glass, Rock or Slag wool fibers)		
Molybdenum (as Mo) –Soluble compounds (as respirable particulate)			0.5 mg/m³		N95	
–Insoluble compounds (as inhalable particulate)			10 mg/m³		N95	
(as respirable particulate)			3 mg/m³		N95	
Monochloroacetic acid		0.288mg/m ³	1 mg/m³ (AIHAWHEEL)	MCA, MCAA, Chloroethanoic acid	(F)OV/N95	
Monochlorobenzene				(See Chlorobenzene)		
Monomethyl aniline				(See Methyl aniline)		
Monomethyl hydrazine				(See Methyl hydrazine)		
Morpholine	8000	0.036	20 -skin-	Tetrahydro-1,4-oxazine; Diethylenimide oxide	(F)OV	
Naphtha (coal tar)	10,000		100 (PEL)	Naphtha, Crude solvent coal tar naphtha, High solvent naphtha, Rubber solvent	(F)OV	Odor variable. Irritation also provides warning.
Naphthalene	500	0.015	10	White tar, Naphthalin	OV	3M 3510 Monitor. See Comment E, page 8.
Nickel (as Ni) –Elemental/metal			1.5 mg/m³ (inhalable)		N95	
–Insoluble compounds			0.2 mg/m³ (inhalable)		N95	
–Soluble compounds			0.1 mg/m³ (inhalable)		N95	
Nickel carbonyl	7	0.5-3.0	0.001 (PEL)	Nickel tetracarbonyl	SA(F)	0.05 ppm TLV-TWA. Unknown sorbent effectiveness.
Nickel subsulfide			0.1 mg/m³ (inhalable)		N95	
Nicotine	35 mg/m ³		0.5 mg/m³ -skin-	3-(1-Methyl-2-pyrrolidyl) pyridine	OV/P95	See Comment D, page 7
Nitric acid	100	0.267	2	Aqua fortis, White fuming nitric acid (WFNA), Red fuming nitric acid (RFNA), Hydrogen nitrate	SA(F)	Ineffective sorbents
Nitric oxide	100		25	Nitrogen monoxide, NO	SA	Ineffective sorbents

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
p-Nitroaniline	300 mg/m ³		3 mg/m^{3*} -skin-	Azoic diazo component 37, p-Aminonitro-benzene, Fast red GG base, 4-Nitroaniline, PNA	OV/N95	See Comment D, page 7
Nitrobenzene	200	0.044	1 -skin-	Nitrobenzol, Oil of mirbane	OV	
p-Nitrochlorobenzene	344		0.1* -skin-	PNCB, PCNB, 4-Chloronitrobenzene, p-Chloronitrobenzene, 1-Chloro-4-nitrobenzene	OV	Warning unknown
Nitroethane	1000	2.11	100		(F)OV	
Nitrogen dioxide	50	0.186	3	Nitrogen tetroxide, NTO, Dinitrogen tetroxide, Nitrogen peroxide	SA	Ineffective sorbents. PEL-5 ppm ceiling.
Nitrogen trifluoride	2000		10	Nitrogen fluoride	SA	Warning unknown. Unknown sorbent effectiveness.
Nitroglycerin (NG)	53		0.05* -skin-	Glyceryl trinitrate, Trinitroglycerin	OV	Warning unknown
Nitromethane	1000	3.5	20	Nitrocarbol	OV	
1-Nitropropane	2300	7.09	25		OV	
2-Nitropropane	2300	4.85	10*	sec-Nitropropane	OV	
Nitrotoluene	200	0.017	2* -skin-	Nitrotoluol	OV/N95	See Comment D, page 7
Nitrotrichloromethane				(See Chloropicrin)		
Nitrous oxide			50	Dinitrogen monoxide	SA	Warning unknown. ineffective sorbents.
Nonane		1.26	200	n-Nonane	OV	
Nuisance particulates -Inhalable particulate -Respirable particulate			10 mg/m^{3*} 3 mg/m^{3*}	Particulates not otherwise classified (PNOC)	N95 N95	This category includes many materials. For oils, an R or P95 filter/respirator is recommended.
Octachloronaphthalene			0.1 mg/m³ -skin-	Halowax™ 1051	OV/N95	See Comment D, page 7
Octane (all isomers)	5000	5.75	300*	Normal octane; Isooctane	OV	3M 3510 Monitor
1-Octanol		0.006	50 (AIHAWHEEL)	Alcohol C-8, Capryl alcohol, Heptyl carbinol, n-Octanol, 1-Hydroxyoctane, N-Octyl alcohol	OV	
1-Octene		2	75 (AIHAWHEEL)	a-Octylene, a-Octene	OV	
Oil mist (mineral)			5 mg/m³	White mineral oil, Cutting oil, Heat-treating oil, Hydraulic oil, Cable oil, Lubricating oil	R or P95	As sampled by method that does not collect vapor. 0.005 mg/m ³ TLV-TWA proposed for oils that contain PNAs.

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Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Osmium tetroxide (as Os)	0.1	0.002	0.0002*	Osmic acid	SA(F)	Poor warning. Unknown sorbent effectiveness.
Oxalic acid	500 mg/m ³		1 mg/m³	Oxalic acid dihydrate, Ethane dioic acid	OV/N95	See Comment D, page 7
p,p'-Oxybis(Benzene-sulfonyl hydrazide)			0.1 mg/m³	Benzenesulfonic acid, 4,4'-Oxybis-dihydrazide; OBSH; Diphenyl ether 4,4'-disulfohydrazide	N95	
Oxygen difluoride	0.5	0.098	0.05 (ceiling)	Difluorine monoxide, Fluorine monoxide	SA	Poor warning. Unknown sorbent effectiveness.
Ozone –Heavy work –Moderate work –Light work	10	0.051	0.05 0.08 0.1	Triatomic oxygen	OZ OZ OZ	6000 with 2078 or 2097 filters recommended by 3M for 10X OEL. Not NIOSH approved for ozone.
Paraffin wax fume			2 mg/m³		N95	
Particulate polycyclic aromatic hydrocarbons (PPAH)				(See Coal tar pitch volatiles)		
PCBs				(See Chlorodiphenyl)		
Pentaborane	3	0.97	0.005	Stable pentaborane, Pentaboron nonahydride	SA	Poor warning. Unknown sorbent effectiveness.
Pentachloronaphthalene			0.5 mg/m³	Halowax™ 1013	OV/N95	See Comment D, page 7
Pentaerythritol			10 mg/m³*	Tetramethylolmethane	N95	
Pentaerythritol triacrylate			1 mg/m³ (AIHAWHEEL)	PETA; 2-Propenoic acid, 2-(hydroxymethyl)-2-[[[(1-oxo-2-propenyl) oxy] methyl]-1,3-propanediylester	OV/P95	See Comment D, page 7
1,1,1,2,2-Pentafluoroethane			1000 (AIHAWHEEL)	Pentafluoroethane; HFC-125; Fluorocarbon 125	SA	Ineffective sorbents
Pentane, all isomers	15,000	31.6	600*	Normal pentane	OV	
2-Pentanone				(See Methyl propyl ketone)		
1,1,1,3,3-Pentafluoropropane			300 (AIHAWHEEL)	HFC-245fa, R-245fa, Genetron 245fa	SA	
Pentyl acetate (all isomers)	3000-9000 (depending on compound)		50	Isoamyl acetate, 1-pentanol acetate, 2-pentanol acetate, 3-Pentyl acetate, 2-Methylbutyl acetate, 1,1-Dimethyl-propyl acetate	OV	See Coment E, page 8. 3M 3510 Monitor.
Perchloroethylene	500	6.17	25*	Tetrachloroethylene, Perk	(F)OV	
Perchloromethyl mercaptan	10	0.097	0.1	PMM, Trichloromethyl sulfur chloride	OV	
Perchloryl fluoride	385	11	3	Chlorine oxyfluoride	SA	Poor warning. Unknown sorbent effectiveness.

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Perfluoroisobutylene			0.01 (ceiling)	Octafluoroisobutylene, Octafluoro-sec-butene, PFIB	SA	Warning unknown. Short OV service life.
Perlite			10 mg/m³*	Sodium potassium aluminum silicate	N95	
Persulfates						
-Ammonium			0.1 mg/m³		N95	
-Potassium			0.1 mg/m³		(F)N95	
-Sodium			0.1 mg/m³		(F)N95	
Pesticides				(Call 3M at 1-800-243-4630)		
Petroleum distillates (naphtha)	10,000		500 (PEL)	Petroleum naphtha, Aliphatic petroleum naphtha, Petroleum ether (95 to 115°C), Naphtha (See Gasoline, Stoddard solvent and VM&P Naphtha)	OV	Odor variable
Phenacyl chloride				(See a-Chloroacetophenone)		
Phenol	250	0.011	5 -skin-	Carbolic acid, Monohydroxy benzene	OV/N95	
m-Phenylenediamine			0.1 mg/m³	1,3-Benzenediamine; m-Diaminobenzene	OV/N95	SA preferable if heat involved
o-Phenylenediamine			0.1 mg/m³	1,2-Benzenediamine; o-Diaminobenzene; Orthamine	OV/N95	SA preferable if heat involved
p-Phenylenediamine			0.1 mg/m³ -skin-	p-Diaminobenzene; 1,4-Diaminobenzene	OV/N95	SA preferable if heat involved
Phenyl ether, vapor		0.03	1	Diphenyl ether, Diphenyl oxide	OV	See Comment E, page 8. 3M 3510 Monitor.
Phenyl ether-biphenyl mixture, vapor		0.001-0.01	1 (PEL)	Dowtherm™ A, Diphenyl oxide-diphenyl mixture	OV	See Comment E, page 8
Phenylethylene				(See Styrene)		
Phenyl glycidyl ether			0.1* -skin-	Glycidyl phenyl ether; Phenyl epoxypropyl ether; 1,2-Epoxy-3-phenoxy propane; PGE	OV	Warning unknown
Phenylhydrazine	295		0.1* -skin-	Hydrazinobenzene	(F)OV	Warning unknown
Phenyl mercaptan		0.031	0.5	Benzenethiol, Thiophenol	OV	
Phenylphosphine			0.05 (ceiling)		OV	Warning unknown
Phosgene	2	0.55	0.1	Carbonyl chloride, Carbon oxychloride, Chloroformyl chloride	MG	Poor warning
Phosphine	200	0.14	0.3	Hydrogen phosphide, Phosphorus hydride, Phosphorated hydrogen	SA	Unknown sorbent effectiveness. Fumigant.
Phosphoric acid	10,000 mg/m ³		1 mg/m³	White phosphoric acid, o-phosphoric acid, m-phosphoric acid	(F)N95	N95 with appropriate eye and face protection also acceptable

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Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Phosphorus (yellow)			0.1 mg/m³	White phosphorus, WP	SA	If no phosphorus vapor or phosphine gas present, N95
Phosphorus oxychloride			0.1	Phosphoryl chloride	(F)AG	Warning unknown
Phosphorus pentachloride	200 mg/m ³		0.1*	Phosphoric chloride	AG	Warning unknown
Phosphorus pentasulfide	750 mg/m ³		1 mg/m³	Phosphoric sulfide	N95	
Phosphorus trichloride	50		0.2	Phosphorus chloride	(F)AG	Warning unknown
Phthalic anhydride	1650	0.052	1*	PAN; 1,3-Isobenzofurandione	OV/N95	
m-Phthalodinitrile			5 mg/m³	Isophthalodinitrile, IPN, m-Dicyanobenzene	N95	
2-Picoline		0.003	2 -skin- (AIHAWHEEL)	a-Picoline, 2-Methyl-pyridine	OV	
3-Picoline			2 -skin- (AIHAWHEEL)	b-Picoline, 3-Methyl-pyridine	OV	Warning unknown
4-Picoline			2 -skin- (AIHAWHEEL)	g-Picoline, 4-Methyl-pyridine	OV	Warning unknown
Picric acid		0.0005 mg/m ³	0.1 mg/m³ -skin-	2,4,6-Trinitrophenol, Lyddite, Pertite, Shimose, Melinite	N95	
Piperazine dihydrochloride			5 mg/m³	Dihydrochloride salt of diethylenediamine	N95	
Piperidine		0.372	1 (AIHAWHEEL)	Hexahydropyridine	(F)OV	
Plaster of Paris				(See Calcium sulfate)		
Platinum (as Pt) -Metal			1 mg/m³		N95	
-Soluble salts			0.002 mg/m³		(F)N95	
Polychlorinated biphenyls				(See Chlorodiphenyls)		
Polyethylene glycols			10 mg/m³ (AIHAWHEEL)	PEG, Polyoxyethylene, PGE	R or P95	See Comment G, page 9
Polypropylene glycols			10 mg/m³ (AIHAWHEEL)	PPG	R or P95	See Comment G, page 9
Portland cement (less than 1% quartz)			10 mg/m³*	Hydraulic cement, Cement, Portland cement silicate	N95	
Potassium bromate			0.1 mg/m³ (AIHAWHEEL)	Bromic acid, Potassium salt	N95	
Potassium hydroxide			2 mg/m³ (ceiling)	Caustic potash, Lye, Potassium hydrate	N95	
Propane	20,000	2690	1,000 (PEL)	Dimethyl methane	SA	Poor warning. Ineffective sorbents.
Propargyl alcohol		0.015	1 -skin-	2-Propyn-1-ol	OV	

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Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Rhodium (as Rh)						
-Metal			0.1 mg/m ³ (PEL)		N95	
-Insoluble compounds			0.1 mg/m ³ (PEL)		N95	
-Soluble compounds			0.001 mg/m ³ (PEL)		N95	
Rouge			10 mg/m ³ *	Red iron oxide, Red oxide, Blended red oxides	N95	
Rubber solvent				(See Naphtha [coal tar])		
Selenium and compounds (as Se)			0.2 mg/m ³		N95	
Selenium hexafluoride	5		0.05		SA	Warning unknown. Unknown sorbent effectiveness.
Silane				(See Silicon tetrahydride)		
Silica, amorphous						
-Diatomaceous earth						
Inhalable particulate			10 mg/m ³	Diatomite, Silicon dioxide	N95	
Respirable particulate			3 mg/m ³ *	(amorphous), Diatomaceous silica	N95	
-Precipitated silica			10 mg/m ³		N95	
-Silica, fume			2 mg/m ³ (respirable)	By-product of electro-metallurgical processes	N95	
-Silica, fused			0.1 mg/m ³ (respirable)		N95	
-Silica gel			10 mg/m ³		N95	
Silica, crystalline						
-Cristobalite			0.05 mg/m ³ (respirable)		N95	
-Quartz			0.05 mg/m ³ (respirable)		N95	
-Tridymite			0.05 mg/m ³ (respirable)		N95	
-Tripoli			0.1 mg/m ³ (respirable)		N95	
Silicon			10 mg/m ³ *		N95	

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Silicon carbide					N95	
- Nonfibrous particles (containing no asbestos and <1% crystalline silica)						
Inhalable particulate mass			10 mg/m³		N95	
Respirable particulate mass			3 mg/m³		N95	
- Fibrous forms (including whiskers)						
Respirable fibers			0.1 f/cc		N95	
Silicon tetrahydride			5	Silane	SA	Warning unknown
Silver, metal and soluble compounds (as Ag)			0.01 mg/m³ (PEL)		N95	
Soapstone			3 mg/m³ (respirable)	Massive talc, Steatite, Soapstone silicate	N95	
Sodium azide				Hydrazoic acid		
-as Sodium azide			0.29 mg/m³ (ceiling)		N95	
-as Hydrazoic acid vapor			0.11 (ceiling)		SA	Warning unknown. Unknown sorbent effectiveness.
Sodium bisulfite			5 mg/m³	Sodium hydrogen sulfite	AG/N95	N95 alone suitable if irritation eliminated
Sodium fluoroacetate	5 mg/m ³		0.05 mg/m³ -skin-	1080, Sodium monofluoroacetate, SFA	N95	
Sodium hydroxide	250 mg/m ³		2 mg/m³ (ceiling)	Caustic soda, Soda lye, Lye	N95	
Sodium hypochlorite			2 mg/m³ (AIHAWHEEL)	Hypochlorous acid, sodium salt; Sodium oxychloride	N95	15 minute TWA
Sodium metabisulfite			5 mg/m³	Sodium pyrosulfite	AG/N95	N95 alone suitable if irritation eliminated
Starch			10 mg/m³*	Corn starch	N95	
Stearates			10 mg/m³	Aluminum stearate, Calcium stearate, Glycerol stearate, Lithium stearate, Potassium stearate, Zinc stearate	N95	
Stibine	40		0.1	Hydrogen antimonide, Antimony trihydride	SA	Warning unknown. Unknown sorbent effectiveness.
Stoddard solvent	5150	1-30	100*	Dry cleaning safety solvent, Mineral spirits	OV	3M 3510 Monitor
Strontium chromate (as Cr)			0.0005 mg/m³	Strontium yellow, C.I. pigment yellow 32	N95	
Strychnine	3 mg/m ³		0.15 mg/m³		N95	
Styrene	5000	3.44	20*	Phenylethylene, Vinyl benzene, Cinnamene, Styrene monomer	OV	3M 3510 Monitor

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Subtilisins			0.0006 mg/m³ (ceiling)	Proteolytic enzymes as 100% crystalline enzyme	SA	Difficult to measure 10X OEL. N95 acceptable with suitable air sampling data.
Sucrose			10 mg/m³*	Table sugar, Saccharose	N95	
Sulfur dioxide	100	0.708	2*	SO ₂	AG	Irritation and taste also provide warning
Sulfur hexafluoride			1000	SF ₆	SA	Warning unknown. Unknown sorbent effectiveness.
Sulfuric acid	80 mg/m ³	0.15	1 mg/m³	Oil of vitriol	(F)N95	N95 with appropriate eye protection acceptable if irritation prevented
Sulfur monochloride	10	0.001	1 (ceiling)	Sulfur chloride, Sulfur subchloride	(F)AG	
Sulfur pentafluoride	1		0.01 (ceiling)	Disulfur decafluoride	AG	Warning unknown
Sulfur tetrafluoride			0.1 (ceiling)		AG	Warning unknown
Sulfuryl fluoride	1000		5		SA	Warning unknown. Unknown sorbent effectiveness.
Synthetic vitreous fibers						
–Continuous filament glass fibers			1 f/cc		N95	
–Glass wool fibers			1 f/cc		N95	
–Refractory ceramic fibers			0.2 f/cc		N95	
–Rock wool fibers			1 f/cc		N95	
–Slag wool fibers			1 f/cc		N95	
–Special purpose glass fibers			1 f/cc		N95	
Talc (containing no asbestos)			2 mg/m³* (respirable)	Hydrous magnesium silicate, Steatite talc, Non-fibrous talc, Non-asbestiform talc	N95	
Talc (containing asbestos)				(See Asbestos)		
Tantalum, metal and oxide dusts (as Ta)			5 mg/m³		N95	
Tellurium and compounds (as Te)			0.1 mg/m³		N95	
Tellurium hexafluoride (as Te)	1		0.02		SA	Warning unknown. Unknown sorbent effectiveness.
Terephthalic acid			10 mg/m³	p-Phthalic acid; TPA; Benzene-p-dicarboxylic acid; 1,4 Benzenedicarboxylic acids, Tephthol	N95	

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Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Terphenyls			0.5* (ceiling)	o-Terphenyl, m-Terphenyl, p-Terphenyl, Mixed terphenyls, Diphenyl benzenes	N95	OV/N95 may be preferable if heat involved
1,1,1,2-Tetrachloro-2,2-difluoroethane	15,000		500	Refrigerant 112a; Halocarbon 112a; 2,2-Difluoro-1,1,2-tetrachloroethane; Freon® 112a	OV	Warning unknown
1,1,2,2-Tetrachloro-1,2-difluoroethane	15,000		500	Refrigerant 112, Halocarbon 112, Freon® 112	OV	Warning unknown
1,1,2,2-Tetrachloroethane	150	0.21	1* -skin-	Acetylene tetrachloride	OV	3M 3510 Monitor
Tetrachloroethylene				(See Perchloroethylene)		
Tetrachloromethane				(See Carbon tetrachloride)		
Tetrachloronaphthalene			2 mg/m³	Halowax™, Seekay wax, Nibren wax	OV/N95	See Comment D, page 7
2,3,5,6-Tetrachloropyridine			5 mg/m³ (AIHAWHEEL)	Pyridine, 2,3,5,6-tetrachloro	OV/N95	See Comment D, page 7
Tetrachlorosilane			1 (ceiling) (AIHAWHEEL)	Silicon tetrachloride, Silicon chloride	AG/N95	Warning unknown. Reacts rapidly with moisture yielding HCl and silica.
Tetraethylene glycol diacrylate			1 mg/m³ (AIHAWHEEL)	TTEGDA; 2-Propionic acid, oxy-bis-(2,1-ethane-dioxy-2,1-ethanediol) ester	OV/P95	See Comment D, page 7
Tetraethyl lead (as Pb)	40 mg/m³		0.075 mg/m³ (PEL) -skin-	TEL, Lead tetraethyl, Motor fuel anti-knock compound	OV	Warning unknown
1,1,1,2-Tetrafluoroethane			1000 (AIHAWHEEL)	Tetrafluoroethane, HFC134a, HFA134a, Fluorocarbon 134a	SA	Ineffective sorbents
Tetrafluoroethylene			2	Perfluoroethene; Perfluoroethylene; TFE Tetrafluoroethene; 1,1,2,2-Tetrafluoroethylene	SA	
Tetrahydrofuran	20,000	3.8	200	Diethylene oxide, Tetramethylene oxide, THF	OV	3M 3510 Monitor
Tetrahydrofurfuryl alcohol			2 (AIHAWHEEL)	Tetrahydro-2-furanmethanol; Tetrahydro-2-furancarbinol; Tetrahydro-2 furylmethanol	OV	Warning unknown
Tetramethyl lead (as Pb)	40 mg/m³		0.075 mg/m³ (PEL) -skin-	TML, Lead tetramethyl, Motor fuel anti-knock compound	OV	Warning unknown
Tetramethyl succinonitrile, vapor	5		0.5 -skin-	TMSN	OV	Warning unknown
Tetranitromethane	5		0.005*	Tetan	OV	Warning unknown
Tetrasodium pyrophosphate			5 mg/m³	Sodium pyrophosphate	N95	

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Tetryl			1.5 mg/m³	2,4,6-Trinitrophenyl-methylnitramine; N-Methyl-N-2,4,6-tetranitroaniline; Nitramine; Tetralite	N95	
Thallium –Elemental and soluble compounds (as Tl)	20 mg/m ³		0.1 mg/m³ -skin-	Thallium acetate, Thallium carbonate, Thallium hydroxide, etc.	N95	
4,4'-Thiobis(6-tert-butyl-m-cresol)			10 mg/m^{3*}	4,4'-Thiobis(3-methyl-6-tert-butyl phenol)	N95	
Thioglycolic acid			1 -skin-	Mercaptoacetic acid, Thioranic acid	(F)OV	Warning unknown
Thionyl chloride			1 (ceiling)	Sulfurous oxychloride, Sulfur oxychloride	(F)AG	Warning unknown
Tin (as Sn) –Metal and inorganic compounds (except SnH ₄) –Organic compounds	400 mg/m ³		2 mg/m³ 0.1 mg/m³ -skin-		N95 OV/N95	 See Comment D, page 7
Titanium dioxide			10 mg/m^{3*}	Rutile, Anatase, Brookite	N95	
Titanium tetrachloride			0.5 mg/m³ (AIHAWHEEL)	Titanium chloride	AG/N95	
Toluene	2000	0.16	50* -skin-	Toluol, Phenyl methane, Methyl benzene	OV	3M 3510 Monitor
Toluene diamine			0.005 -skin- (AIHAWHEEL)	Diaminotoluene; TDA; Tolyenediamine	N95	
Toluene-2,4-diisocyanate	10	2.14	0.005*	TDI; 2,4-Toluene diisocyanate	OV/N95	Poor warning
p-Toluenesulfonyl chloride			5 mg/m³ (ceiling) (AIHAWHEEL)	4-Methyl-benzenesulfonyl chloride, Tosyl chloride	(F)OV/AG/N95	See Comment D, page 7. HCl and p-toluene sulfuric acid produced by hydrolysis.
m-Toluidine		0.46-5.9	2 -skin-	m-Aminotoluene	(F)OV	Questionable warning
o-Toluidine	100	0.025-6.6	2* -skin-	o-Aminotoluene; o-Methylaniline; 1-Methyl-1,2-amino-benzene; 2-Methylaniline	(F)OV	Questionable warning
p-Toluidine		0.027-3.2	2 -skin-	p-Aminotoluene	(F)OV	Questionable warning
Tributyl phosphate	125		0.2*	Tri-n-butyl phosphate, TBP	OV/P95	
Trichloroacetic acid		0.295	1	TCA	OV/AG	Irritation also provides warning
1,2,4-Trichlorobenzene		2.91	5 (ceiling)		OV	

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Trimellitic anhydride			0.04 mg/m ³ (ceiling)	TMA	OV/N95	Chemical manufacturer's recommendation. See Comment D, page 7.
Trimethoxysilane			0.05 (AIHAWHEEL)		(F)OV	Warning unknown
Trimethylamine		0.001	5*	N,N-Dimethyl methanamine; TMA	(F)AM	AM not specifically approved
Trimethyl benzene		2.4	25	Mesitylene, Pseudocumene, Hemimellitene	OV	3M 3510 Monitor
Trimethylchlorosilane			5 (ceiling) (AIHAWHEEL)	Chlorotrimethylsilane; trimethylchloro silicane; monochlorotrimethylsilicon	(F)OV/AG	
Trimethyl phosphite		0.001	2	Phosphorus acid trimethylester, Methyl phosphite	(F)OV	
Trimethylolpropane triacrylate			1 mg/m ³ (AIHAWHEEL)	2-Propenoic acid, 2-ethyl-2(((1-oxo-2-propenyl) oxy) methyl)-1,3-propanediyl ester	OV/P95	
Trimethylolpropane trimethacrylate			1 mg/m ³ (AIHAWHEEL)	Acrylic acid, triester w/2-ethyl 2 (hydroxymethyl) 1,3 propanediol	OV/P95	
2,4,6-Trinitrophenol				(See Picric acid)		
2,4,6-Trinitrotoluene (TNT)	1000 mg/m ³		0.1 mg/m ³ * -skin-	TNT, Trinitrotoluol, Trinitrotoluene, sym-Trinitrotoluene	OV/N95	See Comment D, page 7
Triorthocresyl phosphate	40 mg/m ³		0.1 mg/m ³ -skin-	o-Tritolyl phosphate, TCP, TOCP tricresylphosphate	R or P95	
Triphenyl amine			5 mg/m ³		N95	
Triphenyl phosphate	1000 mg/m ³		3 mg/m ³	Phenyl phosphate, TPP	N95	OV/N95 preferable if heat involved
Tripoli				(See Silica, crystalline)		
Trisodium phosphate			5 mg/m ³ (AIHAWHEEL)	TSP, Sodium o-phosphate	(F)N95	N95 acceptable with appropriate eye/face protection. 15 min TWA.
Tungsten (as W) -Insoluble compounds -Soluble compounds			5 mg/m ³ 1 mg/m ³		N95 N95	
Turpentine (wood)	1500	100-200	20	Gumspirits, Turps, Wood turpentine, Gum turpentine	(F)OV	See Comment E, page 8
Uranium (as U) -Insoluble compounds -Soluble compounds	30 mg/m ³ 20 mg/m ³		0.05 mg/m ³ (PEL) 0.05 mg/m ³ (PEL)		N95 AG/N95 N95	See 10 CFR 20 Subpart H Halides Other

* TLV is lower than PEL.

NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Urea			10 mg/m³ (AIHAWHEEL)	Carbamide, Carbonyldiamide, Carbonyldiamine, isourea	N95	AM/N95 may be preferable if heat is involved
n-Valeraldehyde		0.006	50	Pentanal, Valeric aldehyde	(F)OV	
Vanadium pentoxide, respirable dust or fume (as V₂O₅)	70 mg/m ³		0.05 mg/m³* (respirable)	Vanadic anhydride, Vanadium oxide	N95	
Vegetable oil, mists			10 mg/m³*		R or P95	
Vinyl acetate		0.603	10	1-Acetoxyethylene, Ethenyl acetate	(F)OV	3M 3510 Monitor
Vinyl benzene				(See Styrene)		
Vinyl bromide			0.5	Bromoethylene	SA(F)	Warning unknown. Short OV service life.
Vinyl chloride		0.253	1 (PEL)	Chloroethylene, Chloroethene, Monochloroethylene, VC, Vinyl chloride monomer, VCM	SA	OSHA allows OV for very short use periods. See 29 CFR 1910.1017.
Vinyl cyanide				(See Acrylonitrile)		
4-Vinylcyclohexene			0.1	4-Vinyl-1-cyclohexene; 4-Vinylcyclohexene-1-butadiene dimer; 4-Ethenyl-1-1-cyclohexene; 1-Vinylcyclohexene-3,4-vinylcyclohex-1-ene; VCH	OV	Warning unknown
Vinyl cyclohexene dioxide			0.1 -skin-	Vinylcyclohexane dioxide, Vinylhexane dioxide	(F)OV	Warning unknown
Vinyl fluoride			1	Fluoroethene, Fluoroethylene, Monofluoroethylene	SA	Warning unknown. Short service life.
Vinylidene chloride		35.5	1 (PEL)	1,1-Dichloroethylene; VDC	OV	Poor warning
Vinylidene fluoride			500	1,1-Difluoroethene; 1,1-Difluoroethylene; Ethene, 1,1-difluoro; Ethylene, 1,1-difluoro; Halocarbon 1132A; VDF; Vinylidene difluoride	SA	Warning unknown. Ineffective sorbents.
N-Vinyl-2-pyrrolidone			0.05	1-Ethenyl-2-pyrrolidinone; Vinylbutyrlactam; Vinylpyrrolidinone; 1-Vinylpyrrolidinone; N-Vinylpyrrolidinone; Vinylpyrrolidone	OV	
Vinyl toluene	5000	10	50*	Methylstyrene, Tolyethylene	(F)OV	See Comment E, page 8. 3M 3510 Monitor.

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NOTE: For explanation of column headings, refer to Format Explanation starting on page 3.

Chemical Name	IDLH (PPM)	Odor Threshold (PPM)	OEL (PPM)	Synonyms	Respirator Recommended (to 10X OEL)	Comments
Vinyltrichlorosilane			1 (ceiling) (AIHAWHEEL)	Trichlorovinylsilane; Trichlorovinyl silicon; Vinylsilicon trichloride; Silane trichlorovinyl; Silane trichloroethenyl; trichlorovinyl silicane	OV/AG	
VM & P Naphtha		1-40	300	Varnish Makers' & Painters' Naphtha, Ligroin	(F)OV	3M 3510 Monitor
Welding fumes (not otherwise classified)			5 mg/m³		N95	
Wood, dust						
–Certain hard woods as beech and oak			1 mg/m³*		N95	
–Soft woods			5 mg/m³		N95	
Xylene (o-, m-, and p-isomers)	1000	0.851 0.324 0.49	100	1,2-Dimethyl-benzene; 1,3-Dimethyl-benzene; 1,4-Dimethyl-benzene	OV	3M 3510 Monitor
m-Xylene a,a'-diamine			0.1 mg/m³ (ceiling) -skin-	MXDA	OV/N95	See Comment D, page 7
Xylidine (as inhalable aerosol and vapor)	150	0.005- 0.06	0.5* -skin-	Aminodimethyl benzene, Aminoxylene dimethylaniline, Dimethylaminobenzene	OV/N95	
Yttrium, metal and compounds (as Y)			1 mg/m³	Specific compound	N95	
Zinc chloride, fume	4800 mg/m ³		1 mg/m³		N95	
Zinc chromate (as Cr)			0.01 mg/m³*	Basic zinc chromate, Zinc potassium chromate, Zinc yellow	N95	
Zinc oxide (Respirable particulate mass)			2 mg/m³	Zincite, Zinc white	N95	
Zinc stearate			10 mg/m³*	Synpro stearate, Zinc distearate, Dermarone	N95	
Zirconium and compounds (as Zr)	500 mg/m ³		5 mg/m³		N95	

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3M's Service Life Software helps calculate end of service life for 3M organic vapor respirator cartridges based on workplace conditions such as contaminant concentration, temperature, work rate and atmospheric pressure.

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3M Select Software® helps you choose the proper respirator for different hazardous environments.

3M Select Software®	
Features	Benefits
Simple to use	Just point and click, then follow the prompts to select an appropriate respirator. Interactive user's manual is on-line.
Accurate	Knowing the contaminants and their concentrations, the program leads you to an appropriate respirator recommendation.
Explains the solution	Helps you understand the selection process.
Combines contaminant reference information from a variety of resources	Includes IDLH, exposure limit, odor threshold, molecular weight and more. No need to acquire and wrestle with a pile of documents. Saves time.
Uses health hazard data to calculate proper solutions when multiple contaminants are present	Analyzes combinations of over 600 different contaminants in varying concentrations.
Traceable audit reports	OSHA requires an audit trail. View or print the audit trail based on the contaminants and concentrations you've selected.

3M™ Respirator Compliance Software Helps Manage Respiratory Protection

3M Respirator Compliance Software helps you develop and manage your respiratory protection program.

Compliance Software	
Features	Benefits
Includes 42 CFR 84 approved products and incorporates changes to the OSHA 1910.134 Respiratory Protection Standard	Eliminates research and legwork. Helps you comply with the latest regulations.
Simple to use	Three main sections: Workplace Records, Standard Operating Procedures and Respiratory Protection Program requirements. The Windows® based program is menu-driven – just point and click. Interactive user's manual is on-line.
Helps you comply with OSHA or CSA regulations.	Helps you develop a customized written respiratory protection program that meets OSHA or CSA regulations.
Automates record-keeping	Alerts you when fit testing, training sessions, medical updates and exposure assessments are due.
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Customized versions available for different industries	Choose from General industry, Automotive aftermarket or Construction versions.
Integrates with 3M Hearing Compliance Software	Allows you to monitor both respiratory protection and hearing conservation programs from one package.
Works on a LAN	Your employees can work from various locations.

3M™ Hearing Compliance Software

3M Hearing Compliance Software helps you develop and manage your hearing conservation program.

3M Hearing Compliance Software	
Features	Benefits
Helps you develop a customized program manual	Helps ensure that your program complies with OSHA regulations.
Organizes record-keeping	Tracks audiogram dates, standard threshold shifts, personal and area exposure assessments and training records.
Provides extensive reporting capability	Alerts you when tasks are coming due. Allows you to view the status of records by locations, people or types of record. Prepares you for an audit.
Integrates with 3M Respirator Compliance Software	Allows you to monitor both respiratory protection and hearing conservation programs from one package.
Imports employee names	No need to type in employee names and numbers. Just load them in from existing programs.

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3M offers two training courses that provide information for effectively operating a respiratory protection program. The courses are unique among those offered by respirator manufacturers in that they are based on the technical and regulatory aspects of a sound respirator program, rather than specific products. A large equipment display from a number of respirator manufacturers is used to supplement the classroom and workshop presentations.

Respiratory Protection is a comprehensive 4 1/2 day course intended for anyone who manages all or part of a respiratory protection program. All respirator types and each element of a respirator program are thoroughly discussed. Workshop sessions are used extensively to reinforce the course material.

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The 2004 schedule of course dates and locations is listed below. For more information or to enroll, please do one of the following:

- Phone 1-800-659-0151, ext. 275
- Visit our Web site at www.3M.com/occsafety/html/schedule.html and follow the prompts.
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2004 Schedule of Courses

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March 1-5	San Diego, CA
April 26-30	New Orleans, LA
July 12-16	Minneapolis, MN
September 27-October 1	Denver, CO
October 25-29	Seattle, WA

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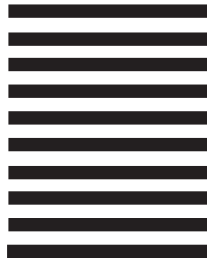


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