# COMPOUND GUIDE FOR
# 3M #3500 ORGANIC VAPOR MONITOR

## I. RECOMMENDED COMPOUNDS

THE TABLE BELOW GIVES THE SAMPLING RATES OF MANY ORGANIC COMPOUNDS FOR WHICH THE 3M #3500 ORGANIC VAPOR MONITOR IS RECOMMENDED FOR ACCURATE SAMPLING. THE TABLE IS NOT EXHAUSTIVE AND WILL BE UPDATED PERIODICALLY. TO GUARANTEE RECEIPT OF PERIODIC UPDATES, COMPLETE AND SEND THE REGISTRATION CARD CONTAINED IN EVERY BOX OF MONITORS.

The (*) compounds have been subjected to an extensive amount of laboratory work in order to verify both the Sampling Rate and the Recovery Coefficient. This thorough lab verification may eliminate as much as 10% error which may occur when using published diffusion coefficient data to calculate sampling rates. The working range given is for normal humidity and is from the minimum detectable amount to the upper exposure limit. Individual 3M Qualification Data Sheets can be supplied to the analyst for each of the (*) compounds.

The Sampling Rates given for the remaining compounds in this table were calculated from published diffusion coefficients which have not yet been verified experimentally by the 3M Laboratory. Sampling Rates obtained in this manner may differ by as much as 10%, but usually no more than 4% from a value experimentally determined. However, results obtained are well within the accuracy and precision required of monitoring systems by NIOSH/OSHA.

Recovery Coefficients are not yet available for all compounds. The procedure would be the same as used by the 3M Laboratory to determine the Recovery Coefficients for the (*) compounds and is available to the analyst.

| Compound | Working Range[a] (ppm-hours)[b] | Sampling Rate ($cm^3$/min.) | Average Recovery Coefficient |
|---|---|---|---|
| *Acetone | 2.5 - 1800 | 35.4 | 0.93 |
| *Acrylonitrile | 2.0 - 300 | 37.1 | 0.84 |
| Allyl Alcohol | 2.5 - 1800 | 36.1 | |
| Allyl Chloride | 2.5 - 1800 | 34.5 | |
| Amyl Acetate | 0.8 - 2000 | 21.6 | |
| Amyl Alcohol | 1.0 - 1500 | 25.3 | |
| sec-Amyl Alcohol | 1.0 - 2000 | 25.8 | |
| Amyl Butyrate | 0.5 - 3000 | 17.2 | |

| Compound | Working Range[a] (ppm-hours)[b] | Sampling Rate ($cm^3$/min.) | Recovery Coefficient |
|---|---|---|---|
| Amyl Isobutyrate | 0.5 - 3000 | 17.6 | |
| Amyl Formate | 0.8 - 2000 | 23.5 | |
| iso-Amyl Formate | 0.8 - 2000 | 23.9 | |
| Amyl Propionate | 0.8 - 2000 | 19.8 | |
| *Benzene | 0.8 - 2000 | 33.0 | 0.99 |
| Benzonitrile | 0.8 - 2000 | 25.1 | |
| Benzyl Acetate | 0.5 - 3000 | 21.2 | |
| Benzyl Alcohol | 0.8 - 2000 | 25.2 | |
| Benzyl Chloride | 0.8 - 2000 | 25.2 | |
| Bromoform | 5.0 - 350 | 27.2 | |
| Butyl Acetate | 1.0 - 2000 | 23.8 | |
| Isobutyl Acetate | 1.0 - 2000 | 24.4 | |
| Butyl Alcohol | 1.2 - 1500 | 30.5 | |
| Isobutyl alcohol | 1.2 - 1500 | 31.2 | |
| sec-Butyl Alcohol | 1.2 - 1500 | 31.5 | |
| t-Butyl Alcohol | 1.2 - 1500 | 30.9 | |
| Butyl Ether | 1.0 - 2000 | 19.0 | |
| Butyl Propionate | 1.0 - 2000 | 21.5 | |
| *Carbon Tetrachloride | 5.0 - 500 | 26.5 | 1.02 |
| Cellosolves | | | |
| Cellosolve (Ethylene glycol monoethyl ether) | 2.5 - 2000 | 27.9 | |
| Cellosolve Acetate (Ethylene glycol monoethyl ether acetate) | 0.8 - 3000 | 21.6 | |
| Methyl Cellosolve (Ethylene glycol monomethyl ether) | 2.5 - 1800 | 29.7 | |
| Diethylene Glycol | 2.5 - 2000 | 25.8 | |
| Diethylene Glycol Monoethyl Ether | 1.0 - 2500 | 21.6 | |
| Chlorobenzene | 0.8 - 2000 | 26.4 | |
| *Chloroform | 5.0 - 350 | 31.6 | |
| p-Cymene | 0.5 - 3000 | 22.3 | |
| Diacetone Alcohol | 1.0 - 2000 | 22.9 | |
| 1, 2-Dibromoethane | 2.5 - 500 | 29.2 | |
| Dibutyl Phthalate | 0.8 - 3000 | 14.9 | |
| 1, 1-Dichloroethane | 2.5 - 350 | 32.5 | |
| 1, 2-Dichloroethane (ethylene dichloride) | 2.5 - 350 | 32.1 | |

| Compound | Working Range[a] (ppm-hours)[b] | Sampling Rate ($cm^3$/min) | Recovery Coefficient |
|---|---|---|---|
| Dichloromethane (methylene chloride) | 5.0 - 100 | 37.9 | 0.92 |
| Dioxane | 2.5 - 1500 | 32.6 | |
| Diethyl Phthalate | 0.8 - 2000 | 17.6 | |
| *Ethyl Acetate | 1.2 - 3000 | 29.4 | 0.98 |
| Ethyl Benzene | 0.8 - 2000 | 26.7 | |
| Ethyl Bromide | 2.5 - 200 | 35.0 | |
| Ethyl Butyrate | 0.8 - 3000 | 23.7 | |
| Ethylene Chlorohydrin | 2.5 - 200 | 34.1 | |
| Ethylene Dichloride | (see 1,2-Dichloroethane) | | |
| Ethyl Ether | 2.5 - 100 | 32.5 | |
| Ethyl Propionate | 1.2 - 3000 | 27.1 | |
| *Heptane | 0.8 - 900 | 27.7 | 1.04 |
| *Hexane | 0.8 - 1500 | 28.2 | 0.95 |
| Isobutyl Acetate | 1.0 - 2000 | 24.4 | |
| Isobutyl Alcohol | 1.2 - 1500 | 31.2 | |
| Isopropyl Acetate | 1.0 - 3000 | 27.3 | |
| Isopropyl Benzene | 0.5 - 2000 | 24.0 | |
| Mesitylene | 0.8 - 2000 | 23.5 | |
| Mesityl Oxide | 0.8 - 2000 | 26.9 | |
| Methyl Acetate | 2.5 - 500 | 34.6 | |
| Methyl Butyrate | 1.0 - 2000 | 26.4 | |
| Methyl Chloroform | (see 1,1,1-Trichloroethane) | | |
| Methyl Isobutyrate | 1.0 - 2000 | 26.5 | |
| Methyl Isobutyl Ketone | 2.0 - 1800 | 26.6 | |
| *Methyl Ethyl Ketone | 2.5 - 400 | 31.2 | 0.95 |
| Methyl Propionate | 1.0 - 1500 | 30.5 | |
| Methyl Propyl Ketone | 2.0 - 1500 | 28.1 | |
| Methylene Chloride | (see Dichloromethane) | | |
| Nitrobenzene | 0.8 - 2000 | 25.5 | |
| Octane | 0.8 - 2000 | 21.8 | |
| Pentane | 1.0 - 500 | 29.8 | |
| Perchloroethylene | (see Tetrachloroethylene) | | |
| Propyl Acetate | 1.0 - 3000 | 27.2 | |
| *Stoddard Solvent | | 24.3 | 1.00 |
| *Styrene | 0.8 - 2000 | 27.3 | 0.97 |
| 1,1,2,2-Tetrachloroethane | 2.5 - 500 | 25.6 | |

| Compound | Working Range[a] (ppm-hours)[b] | Sampling Rate ($cm^3$/min) | Recovery Coefficient |
|---|---|---|---|
| Tetrachloroethylene (Perchloroethylene) | 2.5 - 500 | 28.2 | 0.99 |
| *Toluene | 0.8 - 2000 | 30.4 | 1.00 |
| *Trichloroethylene | 2.5 - 2000 | 28.0 | |
| *1,1,1-Trichloroethane | 2.5 - 500 | 28.1 | |
| 1,1,2 Trichloroethane | 2.5 - 500 | 28.0 | |
| *Vinyl Chloride | 2.5 - 30 | 40.7 | 0.90 |
| *m-Xylene | 0.8 - 2000 | 25.6 | 1.00 |
| o-Xylene | 0.8 - 2000 | 25.7 | 1.00 |
| p-Xylene | 0.8 - 2000 | 23.7 | 1.00 |

(a) Working range values listed are determined at normal relative humidity. Upper limits may be substantially reduced at high relative humidity.

(b) The product of concentration in ppm and exposure time in hours. It shows that a combination of the two factors determines total exposure.

For example, for benzene the minimum detectable exposure may be reached through several combinations including:

0.8 ppm X 1 hour = 0.8 ppm-hours = 0.10 ppm X 8.0 hours

And the upper exposure limit by:

250 ppm X 8 hours = 2000 ppm-hours = 500 ppm X 4 hours

## II. UNSUITABLE COMPOUNDS

The OVM is not recommended for the compounds listed below because of adverse or inadequate interactions with the sorbent material.

| Compound |
|---|
| Carbon Monoxide |
| Ethylene Oxide |
| Formaldehyde |
| Hydrogen Sulfide |
| Isocyanates |
| Methane, Ethane, Propane |
| Methyl Alcohol (Methanol) |
| Methyl Chloride |
| Methyl, Dimethyl, Trimethyl Amines |
| Organic Solids |
| Sulfur Dioxide |

These lists are not exhaustive. If you have a specific request not covered in this Guide, please write to Occupational Health and Safety Products Division, 3M Company, 3M Center, St. Paul, MN 55101; or call on 800-328-1300.

## III. Calculation Procedure[c]

1) Determine weight of analyte in micrograms (µg).

2) Establish exposure time in minutes.

3) From Table I, Recommended Compounds, obtain:

   a) Sampling Rate ($cm^3$/min.)
   b) Recovery Coefficient for (*) compounds.
   c) Procedure for determining Recovery Coefficients is enclosed.

4) Calculate concentration by substituting values for the terms in the equation below:

$$\frac{mg}{m^3} = \frac{1000 \text{ (weight of analyte)}}{\text{(Sampling Rate)(Recovery Coefficient)(Exposure Time)}}$$

Determine ppm[d] by multiplying the value obtained above for $mg/m^3$ as follows:

$$ppm = \frac{mg}{m^3} \times \frac{24.45}{\text{(Molecular Weight)}}$$

(c) See sample calculation on next page.
(d) ppm based on 25°C, 760 mm Hg.

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## SAMPLE CALCULATION

Weight of analyte (benzene) determined by gas chromatography:

27.2 micrograms

Exposure time = 7 hours (420 minutes)

To calculate the exposure concentration the following equation is used:

1. $$\frac{mg}{m^3} = \frac{1000\ (\text{weight of analyte})}{(\text{Sampling rate})(\text{recovery coefficient})(\text{exposure time})}$$

*Weight of analyte = 27.2 micrograms (µg)
Monitor sampling rate = 33.0 cubic centimeters per minute ($cm^3$/min.)
Recovery Coefficient = 0.99
1000 nanograms (ng) = 1 microgram (µg)
Substituting the numerical values and units into the equation above,

2. $$\frac{mg}{m^3} = \frac{1000\ \frac{ng}{\mu g} \times 27.2\ \mu g}{33.0\ \frac{cm^3}{min}\ (0.99)(420\ min)} = 1.98\ ng/cm^3$$

Since $ng/cm^3 = mg/m^3$,

$$\frac{mg}{m^3} = 1.98$$

To determine ppm, the following equation is used:

3. $$ppm = \frac{mg}{m^3} \times \frac{22.4\ l/mole}{MW\ g/mole} \times \frac{T°K}{273°K} \times \frac{760\ mm\ Hg}{P\ mm\ Hg}$$

Based on 25°C, 760 mm Hg the equation reduces to,

4. $$ppm = \frac{mg}{m^3} \times \frac{24.45}{MW}$$

Substituting for the molecular weight (M.W.) of benzene, 78.11 and the value obtained for $mg/m^3$.

$$ppm = 1.98 \times \frac{24.45}{78.11} = 0.62$$

*Weight of analyte is derived from an equation using nanograms, therefore conversion to micrograms is necessary in equation 2.