UNITS AND UNIT CONVERSIONS FACT SHEET

Introduction

This fact sheet summarizes the common units used for air and soil vapor concentrations that may be encountered in vapor intrusion investigations and provides information to help practitioners convert concentration units. Units and unit conversions can be a source of confusion in interpreting vapor intrusion data (see the Common Mistakes in Vapor Intrusion Evaluations, Investigations, and Mitigation Fact Sheet), and it is prudent to be diligent about units to avoid representing or interpreting data incorrectly.

Units for Air Media (Soil Vapor, Air)

Various units are used to report air or soil vapor concentrations. Concentrations are reported either on a mass per volume basis (e.g., grams of a chemical per liter of air) or volume per volume basis (e.g., liters of a chemical per liter per air). These units include the following:

- Mass per volume units:
  - micrograms per cubic meter ($\mu g/m^3$)
  - micrograms per liter (µg/L)
  - milligrams per cubic meter (mg/m^3)
- Volume per volume units
  - parts-per-billion-volume (ppbv)
  - parts-per-million-volume (ppmv)
  - percent (%)

Air and soil vapor screening levels are typically presented in units of $\mu g/m^3$. Some laboratories may report results in ppbv, and some may report results in both $\mu g/m^3$ and ppbv. Units should be checked prior to starting the data evaluation and risk evaluation process. If analytical results for air or soil vapor samples are reported in units that are different from comparison values (e.g., screening levels), a unit conversion is necessary to compare the measured concentrations to those values. To avoid the potential for confusion, it is advisable to ask the analytical laboratory to report all results in units of $\mu g/m^3$. This will avoid the need to perform unit conversions.

Unit Conversions for Air Media

Conversions between different mass per volume units are a function of adjusting for the differences in mass or volume units. For example, there are 1,000 L/m^3, so a factor of 1,000 is used to convert from µg/L to $\mu g/m^3$. Conversion factors for common mass per volume units are provided in Table 1. Note that concentrations expressed in µg/L and mg/m^3 are equivalent, because there are 1,000 µg per mg and 1,000 L per m^3.

Table 1. Unit conversion factors for mass per volume.

Original Units	New Units		
	$\mu g/m^3$	µg/L	mg/m^3
$\mu g/m^3$	1	0.001	0.001
µg/L	1,000	1	1
mg/m^3	1,000	1	1

Note: µg/L = micrograms per liter, $\mu g/m^3$ = micrograms per cubic meter, mg/m^3 = milligrams per cubic meter.

Conversions between different volume/volume units are a function of adjusting for the fractions used in the concentrations (e.g., 1 per 1 billion, 1 per 1 million, or 1 per 100 [%]). Conversion factors for common mass per volume units are provided in Table 2.

Table 2. Unit conversion factors for different volume/volume.

Original Units	New Units		
	ppbv	ppmv	%
ppbv	1	0.001	0.0000001
ppmv	1,000	1	0.0001
%	10,000,000	10,000	1

Note: ppbv = parts per million by volume, ppmv = parts per million by volume.

Conversion from mass per volume-based concentration units to volume per volume units is dependent on the molecular weight of a compound as well as the molar volume of gas (which is a function of temperature and pressure) and, therefore, requires other equations to perform the unit conversions. These are discussed below.

Online Resources

Online tools are available to perform unit conversions. Examples of online tools include the U.S. Environmental Protection Agency's Indoor Air Unit Conversion (USEPA 2025) and Eurofins's Unit Conversion Calculator (Eurofins 2025). Other calculators can be found using online search engines.

Unit Conversion Calculations

Details on unit conversion calculations are provided in this section and are based on the ideal gas law. Assuming a temperature of 25°C and pressure of 1 atmosphere, the molar volume of a gas is 24.45 L/mol. This factor and the chemical's molecular weight are used to convert the volume of a gas to the amount of the gas. The second equation is used to convert from ppbv to µg/m^3.

Convert concentration (C) in µg/m^3 to ppbv:

$$C\ \ (ppbv) = \frac{24.45(\frac{L}{mol})\ x\ C\ \ (\frac{\mu g}{m^3})}{MW(\frac{g}{mol})} \times \frac{10^9\ ppb}{10^6(\frac{\mu g}{g}) \times 10^3(\frac{L}{m^3})}$$

Convert from ppbv to µg/m^3:

$$C\ \ \left(\frac{\mu g}{m^3}\right) = \frac{MW\ (\frac{g}{mol})\ x\ C\ \ (ppbv)}{24.45\ (\frac{L}{mol})} \times \frac{10^6(\frac{\mu g}{g}) \times 10^3(\frac{L}{m^3})}{10^9\ ppb}$$

Conversions between µg/L or mg/m^3 and ppmv are analogous to the above.

If temperature and pressure vary from these values (e.g., at high elevation sampling sites), then the molar volume for gas can be adjusted using the following equation and then inserted into the unit conversion equation in lieu of the 24.45 L/mol value:

$$Molar\ Volume\ \left(\frac{L}{mol}\right) = 24.45\ \left(\frac{L}{mol}\right) x\ \frac{1\ atm}{P\ (atm)} \times \frac{T(\ ^\circ C) + 273}{25\ \ ^\circ C + 273}$$

Example unit conversions between ppbv and µg/m^3 are provided in Table 3 and assume a temperature of 25°C and 1 atmosphere pressure.

Table 3. Example unit conversions for common vapor-forming chemicals at 25°C and 1 atmosphere pressure.

Chemical	CAS Number	Molecular Weight	Results in ppbv	Results in µg/m^3
Benzene	71-43-2	78.11	1	3.19
1,2-dichloroethane	107-06-2	98.96	1	4.05
1,2-dichloroethene (cis)	156-59-2	96.94	1	3.96
1,2-dichloroethene (trans)	156-60-5	96.94	1	3.96
Ethylbenzene	100-41-4	106.2	1	4.34
Tetrachloroethene (PCE)	127-18-4	165.8	1	6.78
Toluene	108-88-3	92.14	1	3.77
1,1,1-trichloroethane	71-55-6	133.4	1	5.46
Trichloroethene (TCE)	79-01-6	131.4	1	5.37
Vinyl chloride	75-01-4	62.50	1	2.56
Xylenes (-m, -p, or -o)	1330-20-7	106.17	1	4.34

Note: µg/m^3 = micrograms per cubic meter, ppbv = parts per million by volume, ppmv = parts per million by volume.

REFERENCES

Eurofins. 2025. "Unit Conversion Calculator." Eurofins Scientific. https://www.eurofinsus.com/environment-testing/services/air-and-vapor/unit-conversion-calculator/.

USEPA. 2025. "Indoor Air Unit Conversion." EPA On-Line Tools for Site Assessment Calculation. https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/ia_unit_conversion.html.