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Standard Practice for Conversion Units and Factors Relating to Sampling and Analysis of Atmospheres[1]

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1. Scope

1.1 This practice provides units and factors useful for members of the air pollution and meteorological communities.

1.2 This practice is used together with IEEE/ASTM SI-10, which discusses SI units and contains selected conversion factors for inter-relation of SI units and some commonly used non-metric units.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System

3. Significance and Use

3.1 ASTM requires the use of SI units in all its publications and their use in reporting atmospheric measurement data. However, there are historic data and even data currently reported that are based on a variety of units of measurement. This practice tabulates factors that are necessary to convert such data to SI and other units of measurement.

3.2 IEEE/ASTM SI-10 does not list all the conversion factors commonly used in air pollution and meteorological fields. This practice supplements IEEE/ASTM SI-10.

3.3 The values reported here were obtained from a number of standard publications. They were adjusted to five figures and organized in a rational order. All values reflect the latest information from the 16th General Conference on Weights and Measurements held in 1979.

3.4 The factors in Table 1 are provided to change units of measurement from one system to related units in other systems, as well as to smaller or larger units in the same system.

3.5 Values of units in the left column may be converted to values of units in the right column merely by multiplying by the conversion factor provided in the center column.

[1] This practice is under the jurisdiction of ASTM Committee D22 on Air Qualityand is the direct responsibility of Subcommittee D22.01 on Quality Control.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Conversion Units

Multiply	By	To Obtain
	Temperature	
Degrees Fahrenheit (F) + 459.72	1	Degrees Fahrenheit Absolute or Rankine (R)
Degrees Fahrenheit (F) – 32	5/9	Degrees Celsius (C)
Degrees Celsius (C) + 273.15	1	Kelvins (K)
Degrees Celsius (C) + 17.78	1.8	Degrees Fahrenheit (F)
Degrees Rankine (R) – 459.72	1	Degrees Fahrenheit (F)
Kelvins (K) – 273.15	1	Degrees Celsius (C)
	Pressure	
Dynes per square centimetre	1.4504×10^{-5}	Pounds per square inch
	10.197×10^{-4}	Grams per square centimetre
	1×10^{-6}	Bars
	0.1	Pascals
Pounds per square inch absolute (psia)	70.307	Grams per square centimetre absolute
	51.715	Millimetres of mercury absolute
	144	Pounds per square foot absolute
	1	Pounds per square inch gage + 14.696
	6894.8	Pascals
Pounds per square inch gage (psig)	70.307	Grams per square centimetre
	51.715	Millimetres of mercury at 0°C
	27.673	Inches of water at 4°C
	1	Pounds per square inch absolute – 14.696
	6894.8	Pascals
Inches of water (at 4°C)	0.03614	Pounds per square inch
	0.07355	Inches of mercury
	0.57818	Ounces per square inch
	25.399	Kilograms per square metre
	2490.8	Dynes per square centimetre
	249.2	Pascals
Inches of mercury (at 0°C)	0.49116	Pounds per square inch
	13.595	Inches of water at 4°C
	345.31	Kilograms per square metre
	3.3864×10^{4}	Dynes per square centimetre
	3386.4	Pascals
Millimetres of mercury (at 0°C)	0.01934	Pounds per square inch
	1.3595	Grams per square centimetre
	1333.2	Dynes per square centimetre
	133.32	Pascals
Centimetres of mercury (at 0°C)	1.3332×10^{4}	Dynes per square centimetre
	135.95	Kilograms per square metre
	27.845	Pounds per square foot
	1333.2	Pascals
Atmosphere (normal)	760	Millimetres of mercury at 0°C
	1.0133	Bars
	14.696	Pounds per square inch
	29.921	Inches of mercury at 0°C
	1033.2	Grams per square centimetre
	1.0133×10^{6}	Dynes per square centimetre
	1.0132×10^{5}	Pascals
Bars	14.504	Pounds per square inch
	1.0197×10^{4}	Kilograms per square metre
	1.000×10^{6}	Dynes per square centimetre
	750.06	Millimetres of mercury (0°C)
	0.98692	Atmospheres
	10^{5}	Pascals
Pascals	10	Dynes per square centimetre
	1.4504×10^{-4}	Pounds per square inch absolute
	4.0128×10^{-3}	Inches of water (at 4°C)
	2.9530×10^{-4}	Inches of mercury (at 0°C)
	7.5007×10^{-3}	Millimetre of mercury (at 0°C)
	9.8692×10^{-6}	Atmosphere (normal)
	10^{-5}	Bars
	Density	
Grams per cubic centimetre	1	Grams per millilitre
	0.03613	Pounds per cubic inch
	8.3452	Pounds per gallon (U. S.)
	62.428	Pounds per cubic foot
Pounds per cubic foot	0.01602	Grams per cubic centimetre
	5.7870×10^{-4}	Pounds per cubic inch
	Concentration (See also Section 4.)	
Gases in Gas:		
Parts per million by volume (ppm(v))	1	Micromoles of gas per mole of gas
	1×10^{-4}	Percent by volume

TABLE 1 *Continued*

Multiply	By	To Obtain
	Molecular weight/24 450	Milligrams of substance per litre of air (at 25°C and 101.3 kPa pressure)
	1×10^{-6}	Partial pressure of one constituent / Total pressure of mixture
Parts per billion by volume (ppb(v))	1×10^{-3}	Parts per million by volume
One percent by volume	10 000	Parts per million by volume
Milligrams per litre	1000	Milligrams per cubic metre
	1×10^{6}	Micrograms per cubic metre
Milligrams per cubic metre	1×10^{-3}	Milligrams per litre
Micrograms per cubic metre	1×10^{-6}	Milligrams per litre
Liquid and Solid Particles in Gas:		
Milligrams per litre	1×10^{3}	Milligrams per cubic metre
	1×10^{6}	Micrograms per cubic metre
Milligrams per cubic metre	1×10^{-3}	Milligrams per litre
Micrograms per cubic metre	1×10^{-6}	Milligrams per litre
Ounces per thousand cubic feet	1.0012	Grams per cubic metre
Grains per cubic foot	2.2883	Grams per cubic metre
Particles per cubic centimetre	2.8317×10^{4}	Particles per cubic foot
	1×10^{6}	Particles per cubic metre
Particles per cubic metre	1×10^{-6}	Particles per cubic centimetre
	0.02832	Particles per cubic foot
Millions of particles per cubic foot	35.314	Millions of particles per cubic metre
Gases, Liquids, and Solids in Liquids:		
Gram molecular weight per litre	1	Moles per litre
Parts per million by weight	1	Milligrams per litre (where specific gravity of dispersion medium is 1.00)
	Length	
Angstrom units	1×10^{-10}	Metres
	3.9370×10^{-9}	Inches
	1×10^{-4}	Micrometres
	1×10^{-8}	Centimetres
	0.1	Nanometres
Nanometres	1×10^{-9}	Metres
	1×10^{-7}	Centimetres
	10	Angstrom units
Micrometres	3.9370×10^{-5}	Inches
	1×10^{-6}	Metres
	1×10^{-4}	Centimetres
	1×10^{4}	Angstrom units
Millimetres	0.03937	Inches (U. S.)
	1000	Micrometres
Centimetres	0.39370	Inches (U. S.)
	1×10^{4}	Micrometres
	1×10^{7}	Nanometres
	1×10^{8}	Angstrom units
Metres	6.2137×10^{-4}	Miles (statute)
	1.0936	Yards (U. S.)
	39.370	Inches (U. S.)
	1×10^{9}	Nanometres
	1×10^{10}	Angstrom units
Kilometres	0.53961	Miles (nautical)
	0.62137	Miles (statute)
	1093.6	Yards
	3280.8	Feet
Inches (U. S.)	0.02778	Yards
	2.5400	Centimetres
	2.5400×10^{3}	Angstrom units
Feet (U. S.)	0.30480	Metres
	30.480	Centimetres
Yards (U. S.)	5.6818×10^{-4}	Miles
	0.91440	Metres
	91.440	Centimetres
Miles (nautical)	1.1516	Statute miles
	2026.8	Yards
	1.8533	Kilometres
Miles (U. S. statute)	320	Rods
	0.86836	Nautical miles
	1.6094	Kilometres
	1609.4	Metres
	Area	
Square millimetres	0.00155	Square inches
	1×10^{-6}	Square metres
	0.01	Square centimetres
	1.2732	Circular millimetres
Square centimetres	1.1960×10^{-4}	Square yards