

WATER AGENCIES' STANDARDS

Design Guidelines for Water and Sewer Facilities

APPENDIX E UNITS OF MEASURE

1. PURPOSE

The purpose of this section is to provide parameters and their abbreviations for units of measure used in the WAS Design Guidelines.

2. UNITS OF MEASUREMENT

Units of measurement to be used in design calculations shall conform to the United States system of measurement unless industry practice is to use metric units. Commonly used units and their abbreviations are listed in Table E-1.

**Table E-1
Units of Measure**

Parameter	Abbreviation
Flow/Discharges	
(United States) million gallons per day	mgd
(United States) gallons per minute	gpm
(United States) gallons per hour	gph (for chemicals only)
(United States) gallons per day	gpd
cubic feet per second	cfs
cubic feet per minute	cfm
pounds per day	lb/day
pounds per hour	lb/hr
standard cubic feet per minute	scfm (for gases only)
liters per second	lps
Volume	
(United States) gallons	gal
cubic inches	cu in
cubic feet	cu ft
cubic yards	cy yd
acre-feet	ac-ft
liter	l
milliliter	ml
cubic meters	m ³
Weight or Force	
ounce	oz
pounds	lb
ton	ton
kilogram	kg
gram	g
milligram	mg
thousand pounds	kip

Table E-1
Units of Measure
continued

Parameter	Abbreviation
Length	
inches	in
feet/foot	ft
yards	yd
millimeter	mm
meter	m
micron	μ
Area	
acres	ac
square yard	sq yd
square feet	sq ft
square inches	sq in
Velocity	
feet per second	fps
feet per minute	fpm
miles per hour	mph
revolutions per minute	rpm
Pressure	
feet of water	ft water
pounds per square inches	psi
pounds per square inches absolute	psia
pounds per square inches gage	psig
Power	
Kilowatts	kW
Horsepower	hp
Volts ac	Vac
Volts dc	Vdc
amperes	A
milliampere	mA
power factor	pf
frequency	Hz
Temperature/heat	
degrees Centigrade (Celsius)	$^{\circ}\text{C}$
degrees Fahrenheit	$^{\circ}\text{F}$
British Thermal Unit	Btu
Density	
pounds per cubic feet	pcf
pounds per gallon	lb/gal
kilograms per cubic meter	kg/m^3

Table E-1
Units of Measure
continued

Parameter	Abbreviation
Concentration	
milligrams per liter	mg/l
parts per billion	ppb
parts per million	ppm
pounds per million gallons	lb/10 ⁶ gal
pounds per gallon	lb/gal
pounds per cubic feet	pcf
Loadings	
pounds per square inch	psi
pounds per square feet	psf
gallons per day per square foot	gpd/sf
gallons per day per linear foot	gpd/ft
gallons per minutes per square foot	gpm/sf

3. CONVERSION FACTORS

Commonly used USCS to USCS unit conversion factors are listed in Table E-2. Commonly used USCS to metric conversion factors are listed in Table E-3. A simple unit conversion program can be downloaded free of charge with program registration at the following website:

<http://www.joshmadison.com/software/convert/>

Table E-2
Typical Water Industry USCS Conversion Factors

Area	
1 square inch = 0.006944 square foot	1 square foot = 144 square inches
1 square foot = 0.1111 square yard	1 square yard = 9 square feet
1 acre = 43,560 square feet	1 square foot = 2.2956x10 ⁻⁵ acre-foot
Flowrate	
1 cubic foot/second = 448.83 gallons/minute	1 gallon/minute = 0.002228 cubic foot/second
1 cubic foot/second = 646,300 gallons/day	1 gallon/day = 1.547x10 ⁻⁶ cubic foot/second
Length	
1 inch = 0.0833 foot	1 foot = 12 inches
1 foot = 0.3333 yard	1 yard = 3 feet
1 mile = 5,280 feet	1 foot = 1.8939x10 ⁻⁴ mile
1 mile = 1,760 feet	1 yard = 5.6818x10 ⁻⁴ mile
Pressure	
1 pound/square inch = 2.31 feet of water	1 foot of water = 0.4333 pounds/square inch
Velocity	
1 foot/second = 0.6818 mile/hour	1 mile/hour = 1.4667 feet/second

Table E-2
Typical Water Industry USCS Conversion Factors
Continued

Volume	
1 quart = 0.25 gallon	1 gallon = 4 quarts
1 cubic inch = 5.787×10^{-4} cubic foot	1 cubic foot = 1728 cubic inches
1 cubic foot = 0.0370 cubic yard	1 cubic yard = 27 cubic feet
1 cubic foot = 7.4805 gallons	1 gallon = 0.1337 cubic foot
1 acre-foot = 43,560 cubic feet	1 cubic foot = 2.2956×10^{-5} acre-foot
1 acre-foot = 0.3259 million gallons	1 million gallons = 3.0689 acre-feet

Weight	
1 ounce = 0.0625 pound	1 pound = 16 ounces
1 ton = 2000 pounds	1 pound = 5×10^{-4} ton

Table E-3
Typical Water Industry USCS to Metric Conversion Factors

Area	
1 square inch = 6.415 square centimeters	1 square centimeter = 0.155 square inch
1 square foot = 0.0929 square meter	1 square meter = 10.7639 square feet
1 square yard = 0.8361 square meter	1 square meter = 1.196 square yards
1 acre = 0.4047 hectare	1 hectare = 2.471 acres
1 acre = 0.0040 square kilometer	1 square kilometer = 247.1 acres
1 square mile = 2.59 square kilometers	1 square kilometer = 0.3861 square mile

Flowrate	
1 gallon/minute = 0.063 liter/second	1 liter/second = 15.8730 gallons/minute
1 cubic foot/second = 28.2763 liters/second	1 liter/second = 0.0354 cubic foot/second

Force	
1 pound(f) = 4.4482 Newtons	1 Newton = 0.2248 pound(f)

Length	
1 inch = 25.4 millimeters	1 millimeter = 0.03937 inch
1 inch = 2.54 centimeters	1 centimeter = 0.3937 inch
1 foot = 0.3048 meter	1 meter = 3.2808 feet
1 yard = 0.9144 meter	1 meter = 1.0936 yards
1 mile = 1.6093 kilometers	1 kilometer = 0.6214 mile

Power	
1 horsepower = 0.746 kilowatt	1 kilowatt = 1.341 horsepower

Pressure	
1 pound/square inch = 6.8948 kilopascals	1 kilopascal = 0.1450 pound/square inch
1 pound/square foot = 47.8803 kilopascals	1 kilopascal = 0.0209 pound/square foot

Temperature	
1 Deg Fahrenheit = 1.8 (Deg Celsius +32)	1 Deg Celsius = 0.5556 (Deg Fahrenheit -32)

Velocity	
1 foot/second = 0.3048 meter/second	1 meter/second = 3.2808 feet/second

Table E-3
Typical Water Industry USCS Conversion Factors
Continued

Volume	
1 cubic inch = 16.387 cubic centimeters	1 cubic centimeter = 0.0610 cubic inch
1 cubic foot = 0.0283 cubic meter	1 cubic meter = 35.3134 cubic feet
1 cubic yard = 0.7646 cubic meter	1 cubic meter = 1.3079 cubic yards
1 quart = 0.9463 liter	1 liter = 1.0567 quarts
1 gallon = 0.2646 liter	1 liter = 3.78 gallons
Weight	
1 ounce = 28.3495 grams	1 gram = 0.0353 ounce
1 pound = 0.4536 kilogram	1 kilogram = 2.2046 pounds
1 ton = 907.1848 kilograms	1 kilogram = 0.0011 ton

4. REFERENCES

- A. Should the reader have any suggestions or questions concerning the material in this section, contact one of the member agencies listed.

- B. The publications listed below form a part of this section to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said publications unless otherwise called for. The following list of publications, as directly referenced within the body of this document, has been provided for the users convenience. It is the responsibility of the user of these documents to make reference to and/or utilize industry standards not otherwise directly referenced within this document.

END OF SECTION