

Glossary

WATER TERMS

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Absolute Purity Water — Water with a specific resistance of 18.3 megohm-cm at 25°C.

Absorption — Process by which one substance is taken up by another, either chemically or physically, as when a sponge “soaks up” a liquid.

Acid feed — Injecting sulfuric acid into a water stream to make it less alkaline (pH adjustment).

Activated Carbon — Material used to adsorb organic impurities from water. Comes from wood, lignite, pulp-mill char, blood, etc. The source material is initially charred at high temperature to convert it to carbon. The carbon is then “activated” by oxidation from exposure to high-temperature steam. It comes in granular or powdered form.

Adsorption — Adhesion of the molecules of a gas, liquid or dissolved substance to a surface because of chemical or electrical attraction. Typically accomplished with granular activated carbon to remove dissolved organics and chlorine.

Agglomerate — When suspended solids cluster together to form larger clumps or masses, which are easier to remove by filtration or settling.

Alkalinity — Capacity of water to accept protons (H⁺ ions), (i.e., its acid-neutralizing capacity); characteristic of the presence of carbonate (CO₃⁻), bicarbonate (HCO₃⁻), and hydroxyl (OH⁻) ions. Bicarbonate and carbonate ions are expected to be in most waters. Hydroxide may occur in water that has been softened by the lime soda process or has been in contact with fresh concrete. Alkalinity furnishes a guide in choosing appropriate treatment of either raw water or plant effluents.

Alum — aluminum sulfate, commonly added during municipal treatment to cause insoluble colloids to coalesce into larger particles, which can be removed by settling. Also see “Flocculation.”

Angstrom — One ten-thousandth of a micron.

Anion — A negatively charged ion.

Anion Exchange Resin — An ion exchange material that removes anions from solution by exchanging them with hydroxyl ions.

Aquifer — Underground layer of permeable rock, sand or gravel that contains water for wells or springs.

ASTM — The American Society of Testing and Materials.

Atomic Absorption Spectrophotometry — A highly sensitive instrumental technique for identifying and measuring metals in water.

Background Contamination — Contamination introduced accidentally in reagents, dilution water, solvents, rinse water, etc., which can be confused with constituents in samples being analyzed.

Backwash — Some types of filters may be cleaned by reversing the flow of water to force contaminants out of plugged pores and passages.

Baseline — In some analytical procedures the sample is dissolved in water or combined with other reagents for analysis. A “blank” or standard consisting of the same reagents may be analyzed without sample present. This provides a comparative reference point, or baseline, so that test results can be attributed solely to the sample itself.

Bed — Column of carbon, sand or ion exchange resins through which the water passes during treatment.

Biochemical Oxygen Demand (BOD) — The amount of oxygen required to oxidize the dissolved organic matter in a water sample by aerobic (bacterial) decay. It's a measure of the oxygen depletion that would result from discharging organic impurities into a waterway.

Biological Impurities — Impurities resulting from living matter (bacteria, virus, algae, protozoa, microfungi) and their by-products, including pyrogens.

Biopure Water — Water that is sterile, pyrogen free and has a total solids content of less than 1 ppm.

Blank — A preliminary analysis omitting only the sample to provide an unbiased reference point or baseline for comparison. It's important to minimize extraneous contamination that could be confused with constituents in the sample itself.

Boiler — The vessel used in distillation systems to convert water into steam.

Breakthrough — The point at which ions can be detected downstream of an ion exchange bed, indicating that the resin capacity is depleted.

Buffer — A solution that is capable of opposing small changes in chemical composition; particularly in pH.

Calcium — A metallic element often found in water, usually as dissolved calcium carbonate (CaCO₃). Soluble in water, it causes hardness and subsequent scaling.

Carbon — See “Adsorption,” “Activated Carbon.”

Carbonate Hardness — Hardness in water caused by bicarbonates and carbonates of calcium and magnesium.

Cation — A positively charged ion.

Cation Exchange Resin — Ion exchange resins capable of removing cations by exchanging them for hydrogen ions.

Channeling — Failure of a bed caused when water finds furrows or channels through which it can flow without effective contact with the bed.

Chelating Agents — Organic compounds that can withdraw ions from solution, forming insoluble complexes.

Chemical Oxygen Demand (COD) — The amount of oxygen needed to completely oxidize all oxidizable organic and inorganic substances in water.

Chloramine — A chlorine compound formed by reaction with organic amines or ammonia.

Chlorination — Adding chlorine or chlorine compounds to water for disinfection.

Chlorine — An element used to kill micro-organisms in water. At room temperature and atmospheric pressure it is a greenish yellow gas.

Chlorine Demand — Amount of chlorine used up by reacting with oxidizable substances in water before chlorine residual can be measured.

Chlorine Residual — Portion of free or combined chlorine that remains active after specified contact period.

Coagulation — Adding insoluble compounds to water that neutralize the electrical charge on colloids, causing them to coalesce to form larger particles that can be removed by settling. Also referred to as flocculation.

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Coliform Bacteria — A group of bacteria found in mammalian intestines and soil, which are a useful measure of fecal pollution in water. They are easy to identify and count in the laboratory because of their ability to ferment lactose.

Colloids — Particles so fine they will not settle without prior coagulation. They range from 10 to 1,000 Angstroms. They have a net negative charge, and readily clog membranes and foul resin beds. Examples are bacteria, silica and clay.

Concentration Polarization — The phenomenon in ultrafiltration (UF) in which solutes form a dense, polarized layer next to the membrane surface which eventually blocks further flow. UF systems counteract this by continuously flushing the solute away from the membrane surface.

Condensate — Distillate just after it has been cooled from steam into the liquid state.

Condenser — The heat exchanger used in distillation to cool pure steam in order to convert it from the vapor to the liquid phase.

Conductivity — The reciprocal of resistivity, it is a measure of the ability to conduct an electric current. Since ionized impurities increase the conductivity of water, it is also an accurate measure of ionic purity. To measure it, current is passed between two electrodes a fixed distance apart. Conductivity is normally expressed as micromhos/cm.

Critical Point — The combination of pressure and temperature at which the gas and liquid phases of a substance become indistinguishable.

Dalton — Atomic mass unit; A.M.U. = 1.66×10^{-24} grams.

Deionization — Removing dissolved ions from solution by passing it through a bed of ion exchange resins, consisting of polymer beads that exchange hydrogen ions for cations and hydroxyl ions for anions in solution. The ionic impurities remain bound to the resins, and the hydrogen and hydroxyl ions combine with each other to form water.

Deminerlization — Sometimes used interchangeably with deionization, it refers to the removal of minerals and mineral salts using ion exchange.

Desalination — The removal of dissolved salts from brine to produce potable water.

Diffusion — Random thermal motion of particles which cause them to flow from a region of higher concentration to one of lower concentration until they're uniformly distributed.

Dilution — Lowering the concentration of a solution by adding more solvent.

Dilution Factor — The ratio of solvent to solute, by volume.

Disinfection — To destroy most (but not necessarily all) of the harmful or objectionable microorganisms by means of chemicals, heat, ultraviolet light, etc. Also referred to as sanitization.

Dissolved Solids — Also referred to as Total Dissolved Solids (TDS), it is the amount of nonvolatile matter dissolved in a water sample, and is usually expressed in parts-per-million by weight.

Distillation — The process of separating water from impurities by heating until it changes into vapor and then cooling the vapor to condense it into purified water.

Effluent — The output or discharge from a water treatment process.

Electrolyte — A chemical compound which, when dissolved or ionized in water, allows it to conduct electric current.

Endotoxin — A poisonous substance present in bacteria that is released when the cell disintegrates. In water treatment, it most often refers to pyrogens. See "Pyrogens."

Evaporator — Apparatus used in distillation to heat water to create a phase change from the liquid to the vapor state. Also called the boiler.

Exhaustion — When absorbents, such as activated carbon or ion exchange resins, have depleted their capacity by using up all active sites. Ion exchange resins may be regenerated to reverse the process.

Extractables — Undesirable foreign substances that are leached or dissolved by water from the materials of construction used in filters, storage vessels, distribution piping and other wetted surfaces.

Feedwater — Water entering a treatment process.

Filtration — Removal of suspended matter by passing it through a porous matrix that prevents particles from getting through, usually by entrapment on or in the filter matrix.

Flocculation — Addition of one or more chemicals to produce a floc, which is an insoluble compound that absorbs colloidal matter and readily settles.

Flow Decay — Measuring the decline in flow rate through a filter to establish a Silt Index for the water being filtered. The Silt Index is a measure of suspended solids and their ability to clog the filter.

Flow Restrictor — A flow-limiting orifice used to control flow rate or pressure drop in a liquid stream.

Fouling — When gelatinous coatings, colloidal masses or dense bacterial growth form a compacted crust on membrane or filter surfaces which blocks further flow.

Gel — A continuous mass formed when colloids congeal.

Grains per Gallon — Concentration of dissolved ions in water, generally as calcium carbonate. 7,000 grains is equal to a pound. One grain per gallon is equivalent to 17.1 ppm of Dissolved Solids (as calcium carbonate). See "Milliequivalent."

Growththrough — A time-related phenomenon in which successive generations of bacteria grow through a membrane filter with pores small enough to prevent passage of the original parent organism.

Hardness — Concentration of calcium and magnesium salts in water. Hardness is a term originally referring to the soap-consuming power of water. As such it is sometimes also taken to include iron and manganese. High hardness can cause boiler or pipe scale and failure of reverse osmosis membranes.

Heat of Vaporization — The amount of heat needed to change a unit volume of water from a liquid to a vapor without a temperature change.

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Hollow Fiber — Refers to reverse osmosis and ultrafiltration membranes formed into small diameter (about 0.05" I.D.) tubes. The inner surface is a very thin (RO or UF) membrane skin supported by a thicker porous outer layer which gives the tube its strength. Hollow fibers are used in bundles of 1,000 or more in a single cartridge shell. Water is forced through the center (upstream surface) of each tube and purified permeate is collected from the outer wall (downstream).

HPLC — High performance liquid chromatography is an instrumental technique for measuring trace levels of organics. Trace organics can be separated into distinct bands in a flowing stream based on their relative attraction to an adsorptive medium. Each band is then profiled as the solvent flows through a UV detector, or fluorescence, or refractive index detectors.

Hydrophilic — Having a strong affinity for water.

Hydrophobic — Non-wetting; water repelling.

Inert — Does not dissolve in water, nor react chemically with other substances.

In-Line — An integral part of the flow path. In a fluid stream, something is said to be in-line if the entire fluid stream flows directly through it.

Inorganic — Commonly referred to as mineral, it includes all matter that is not animal or vegetable. Inorganic substances normally dissociate in water to form ions.

Ion — An atom or group of atoms with an electrical charge that is positive (cation) or negative (anion) as a result of having lost or gained electrons.

Ion Exchange — Also called deionization. A process in which harmless ions attached to the resin beads are exchanged for undesirable ions in solution. Typically, hydrogen ions are exchanged for any cations and hydroxyl ions for any anions. The hydrogen and hydroxyl ions combine to form pure water.

Langelier Index — A measure of the degree of saturation of calcium carbonate in water, which is based on pH, alkalinity and hardness. If the Langelier Index is positive, calcium carbonate can precipitate out of solution to form scale. See "Saturation Index."

Latent Heat of Fusion — The amount of heat needed to change a unit of substance, such as

water, from a solid to a liquid without change in temperature.

Leach — To dissolve by the action of a moving liquid. For example, high purity water leaches trace impurities from glass vessels.

Lipopolysaccharide — Molecule found in the outer cell walls of some bacteria, which trigger the immune response, resulting in fever. Also referred to as pyrogens or as endotoxins, though, strictly speaking, they are not endotoxins.

Macroreticular Resin — An ion exchange resin with a reticular porous matrix that makes it effective for removing colloids and bacteria, as well as dissolved anions. It is especially useful for preventing colloidal and organic fouling of mixed-bed resins and premature clogging of final filters.

Megohm-cm — A measure of ionic purity in water. Resistivity (the reciprocal of conductivity) is a measure of specific resistance to electrical flow. The fewer dissolved ions in water the higher its resistivity. One megohm-cm is equivalent to one million ohms of resistance measured between two electrodes one centimeter apart. The theoretical maximum ionic purity for water is 18.3 megohm-cm at 25°C.

Membrane — Filtration membranes are thin polymer films that are permeable to water and other fluids. Microporous membrane filters have measurable pore structures which physically remove particles or microorganisms larger than pore size. Ultrafiltration membranes, (sometimes called molecular sieves), also remove molecules larger than a specified molecular weight. Reverse osmosis membranes are permeable to water molecules, and very little else, rejecting even dissolved ions in water.

Mho — Unit of measurement for conductance; the reciprocal of ohm (resistance). Also see "Megohm-cm."

Micro — Prefix meaning one millionth, as in micrometer, micrometer.

Micrometer — One millionth of a meter. Still widely referred to as a micron in the U.S., although micrometer is now the internationally accepted standard.

Micromho — A measure of conductance equal to one millionth of a mho.

Micron — See "Micrometer."

Milli — Prefix meaning thousandths, as in milliliter, milligram.

Milliequivalent — To simplify the calculation of ion exchange resin capacity, total dissolved ion concentrations are usually converted into equivalent concentrations of calcium carbonate, the most common source of dissolved ions in water. Resin capacity is normally given in ppm as CaCO₃, or in grains per gallon as CaCO₃ (7,000 grains = 1 pound). However, it may also be given as milliequivalents per liter (meq/l). Since calcium carbonate has a molecular weight of 100 and an equivalent weight of 50 (because calcium has a valence of two), ppm as CaCO₃ can be converted to meq/L by dividing by 50. Thus, 1 ppm of CaCO₃ = 0.02 meq/l. Also see "Grains Per Gallon."

Mixed-Bed Ion Exchange — Mixing both anion and cation resins in the same deionizer results in higher efficiency, but lower capacity than separate-bed deionizers.

Molecular Weight — The weight of a molecule that may be calculated as the sum of the atomic weights of its constituent atoms. Atomic weight is the weight of an element in relation to some element taken as the standard, usually oxygen (16) or carbon (12).

Nano — A prefix meaning billionths, as in nanogram, nanosecond. One nanogram per liter is equal to one part-per-trillion (ppt is used only in U.S.).

NCCLS — National Committee for Clinical Laboratory Standards.

Nominal Pore Size — Based on retention efficiency, a filter should retain 99.9% of all particles larger than its nominal rated pore size.

Noncarbonate Hardness — Hardness in water caused by chlorides, sulfates and nitrates of calcium and magnesium. See "Hardness."

Ohm — The practical unit of electrical resistance in a circuit, where a potential difference of one volt produces a current of one ampere.

Organic — Organic matter is a broad category that includes both natural and man-made molecules containing carbon and hydrogen. All living matter in water is made up of organic molecules. The most common are by-products of vegetative decay, such as tannins, lignins and humic acid.

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Osmosis — The diffusion of a solvent through a semipermeable membrane from a less concentrated solution to a more concentrated solution.

Particulate — Usually a solid particle large enough to be removed by filtration. Nonfilterable solids are usually referred to as colloids.

Percent Recovery — In reverse osmosis or ultrafiltration, the ratio of pure water output to feedwater input.

Percent Rejection — In reverse osmosis or ultrafiltration, the ratio of impurities removed to total impurities in the incoming feedwater. For example, RO membranes typically remove (reject) 90% of the dissolved inorganic contaminants in water.

Permeate — In reverse osmosis, the water that diffuses through the membrane, thereby becoming purified water.

pH — The negative log of the hydrogen-ion concentration. A solution with a pH lower than 7 is acidic. If its pH is higher than 7 it is alkaline.

Pico — A prefix meaning one trillionth, as in picogram.

Polished Water — High purity water after it has undergone a second treatment step. Ultrapure water usually undergoes two or more treatment steps: more economical pretreatment processes (e.g., reverse osmosis) are used to remove all but a very small fraction of the impurities, and highly efficient polishing processes (e.g., mixed-bed deionization) are used to remove the impurities that remain.

Potable — Suitable for drinking.

PPB — Parts per billion, or micrograms per liter. Abbreviated ppb only in U.S. One part per billion is like seeing a bottle cap on the earth's equator from an orbiting satellite.

PPM — Parts per million. The most common measure of dissolved ionized impurities in water. The same as milligrams per liter. For discussion of ppm as a measure of Total Ionized Solids, see "Milliequivalent."

Precipitate — When a solution reaches saturation, solute will begin to come out of solution, as when water precipitates from the air as rain, calcium carbonate precipitates out of water to form scale, or the chalky white substance deposited on the inside of tea kettles.

Pretreatment — Initial water treatment steps performed prior to final processing to prolong the life of cartridges and filters and to protect downstream elements from premature failure. See "Polishing."

Product Water — The purified water produced as a result of treatment.

psig — Pounds per square inch of gauge pressure, or pressure above atmospheric pressure.

Purification — Removal of impurities of concern. It has one meaning when applied to the preparation of drinking water, another when applied to reagent grade water for the laboratory, and still another when applied to water used to rinse integrated circuit devices.

Pyrogens — In water purification, it usually refers to pyrogens of bacterial origin, which are lipopolysaccharides found in the outer cell walls of certain bacteria. Pyrogens trigger the immune response, causing a fever reaction; hence the name pyrogen (heat producing). Bacterial pyrogens were at one time believed to be toxic substances released when bacterial cells disintegrate, and are therefore still referred to as endotoxins.

Reagent Grade Water — Water suitable for use in making up reagents or for use in sensitive analytical procedures. There are several grades of reagent grade water, as defined by various professional organizations, such as ASTM, CAP, NCCLS and ACS: Type I: Used for procedures requiring maximum accuracy and precision, such as atomic spectrometry, flame photometry, enzymology, blood gas, pH and specific ion determinations; reference buffer solutions; and reconstitution of lyophilized materials used as standards. Distillation pretreatment of feedwater is specified by ASTM to produce Type I water. Type II: Recommended for most analytical or general laboratory testing such as hemotological, serological, and microbiological procedures as well as for chemical methods not specifically stated or proven to require Type I quality. ASTM specifies preparation of Type II by distillation and recommends it whenever freedom from organic impurities is important. Type III: Satisfactory for some general laboratory tests; for most qualitative analyses such as urinalysis, parasitology, and histological procedures; for rinsing of analytical samples; preparation of stock solutions; and for washing

or rinsing of glassware (final glassware rinsing should be performed with the water type specified for the procedure performed). Distillation, mixed-bed deionization and reverse osmosis (with high quality feedwater) can be used for Type III.

Recirculation — Continuous recirculation may be necessary to maintain uniformly high purity in larger water systems. Water is continuously recirculated and reprocessed to prevent stagnation and to rinse out residual impurities in the system. Bacteria flourish in stagnant water.

Regenerate — Restore ion exchange capacity of resins by reversing the process. An acid rinse is used to restore cation resin capacity and a sodium hydroxide rinse is used to restore anion resin capacity.

Reject — In reverse osmosis and ultrafiltration, those impurities not able to permeate the membrane are said to be rejected (removed). They are flushed away in the reject (waste) stream.

Resin — Ion exchange resins are usually bead-like spherical materials with an affinity for particular ions. Cation exchange resins, made of styrene and divinylbenzene containing sulfonic acid groups, will exchange hydrogen ions for any cations they encounter. Similarly, anion exchange resins, made of styrene and divinylbenzene containing quaternary ammonium groups, will exchange a hydroxyl ion for any anions.

Resistivity — A measure of specific resistance to the flow of electricity. In water, it is an accurate measure of ionic purity. See "Megohm-cm."

Reverse Osmosis — The reversal of osmosis to purify water. In osmosis, water diffuses through a semipermeable membrane from a less concentrated solution to a more concentrated solution. The flow of water can be reversed with an opposing pressure that exceeds osmotic pressure. With RO, water is forced out of a concentrated solution, leaving the solute (impurities) behind.

Salinity — The concentration of soluble minerals (mainly salts of the alkali metals or of magnesium) in water.

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Salt — Any of numerous compounds that result from replacement of part or all of the acid hydrogen of an acid by a metal or a radical acting like a metal; an ionic or electrovalent crystalline compound.

Salt Rejection — In reverse osmosis, the ratio of salts removed (rejected) to the original salt concentration. See "Percent Rejection."

Saturation Index — The relation of calcium carbonate to the pH, alkalinity and hardness of a water to determine its scale-forming tendency. See "Langelier Index."

Scale — The mineral deposits that can coat the insides of boilers or the surfaces of RO membranes. It consists mainly of calcium carbonate, which precipitates out of solution under certain conditions of pH, alkalinity and hardness. See "Saturation Index."

Sedimentation — A primary step in municipal water treatment. Water is allowed to stand long enough for solids to settle by gravity. Also called settling.

Semipermeable — Membranes that do not have measurable pores, but through which smaller molecules can pass.

Softener — Water treatment equipment that uses a sodium-based ion-exchange resin, principally to remove cations.

Solute — The substance that dissolves to form ions in solution.

Solution — A liquid that contains dissolved solute.

Solvent — A liquid capable of dissolving a solute.

Specific Conductance — The reciprocal of specific resistance, usually expressed in micromhos/cm.

Specific Ion Determinations — Electro-chemical measurement of trace ion levels in solution.

Specific Resistance — Resistance of a one-centimeter cube of water to the passage of electricity under standard conditions, expressed in ohms/cm. It is a measure of the Total Ionized Solids concentration.

Spore — A reproductive cell or seed of algae, fungi, or protozoa.

Sterilization — Destruction or removal of all viable organisms.

Suspended Solids — Undissolved solids that can be removed by filtration. Determined by a filter paper before and after filtration of a water sample.

Tissue Culture — Growing mammalian cells in the laboratory in a tissue culture medium (in vitro). For example, this allows researchers to determine the effects of various chemicals on mammalian cells without experimenting directly on live animals or man. Since a molecule of some toxic substances can harm a single mammalian cell, even one part-per-billion of some impurities can affect a tissue culture. Therefore, water used to make up tissue culture media should be extremely pure.

Total Bacteria Count — An estimation of the total number of bacteria in a sample based, usually, on Standard Methods procedures for collecting, incubating and counting colony-forming units (cfu).

Total Ionized Solids — Concentration of dissolved ions in solution, expressed in concentration units of NaCl (sodium chloride). It determines the operating life of ion exchange resins, and is calculated from measurements of Specific Resistance. Also see "Milliequivalent."

Total Organic Carbon — A measure of the level of organic impurities in water, which determines the operating life of activated carbon beds.

Total Solids — Total solids in water include both dissolved and suspended solids. Determined by weighing sample before and after evaporation.

Trace Analysis — Analyzing constituents present in ppm and ppb concentrations. Trace analysis requires extremely pure reagents, made with ultrapure Type I reagent grade water.

Treatment — Water treatment, also referred to as water conditioning, can consist of adding, as well as removing, chemicals to change the properties of water. In water softening, for example, sodium ions are substituted for ions which cause "hardness," thus reducing the scale-forming tendencies of water. Water purification, on the other hand, always consists of removing undesirable impurities.

Turbidity — A suspension of fine particles that obscures light rays but requires many days for sedimentation because of small particle size.

Two-Bed — Separate beds or layers of cation and anion exchange resins. Results in lower purity than mixed-bed deionization, but provides higher capacity in terms of throughput.

Type I, Type II, Type III — See Reagent Grade Water.

Ultrafiltration — Molecular sieves; membranes with pores small enough to remove large molecules. Rated in terms of nominal molecular weight cutoff. A 10,000 Dalton (molecular weight) UF membrane, for example, will remove bacterial pyrogens, which are typically in the range of 20,000 Daltons.

Ultrapure Water — Water with a specific resistance higher than 1 megohm-cm. In the laboratory, it usually refers to Type I reagent grade water. Anything in laboratory water that is not H₂O is an impurity. Although chemically pure water is not attainable, ultrapure water systems are now capable of reducing impurities down to the limits of detection.

USP — U.S. Pharmacopoeia.

UV Oxidation — Ultraviolet radiation is employed in water purification for the photochemical oxidation of organic impurities, resulting in HPLC grade water with organic impurity levels below 5 ppb.

Vapor Pressure — The pressure at which equilibrium is established between the liquid and gas phases of a substance.

Viable Organism — Capable of living and reproducing. Thus nothing is sterile as long as it contains even a single viable organism.

Virus — An obligate parasite much smaller than bacteria. Regarded as the simplest living microorganisms. Extremely complex molecules that typically contain a protein coat surrounding an RNA or DNA core of genetic material. They are capable of growing and multiplying only in living cells and cause various important diseases.

Viscosity — The tendency of a fluid to resist flowing as a result of molecular attraction (cohesion).

Zeolite — Any of various natural or synthetic hydrated aluminum silicates used as adsorbants in water softening.

Glossary

UNITS OF MEASURE

Barnstead

amp — Unit of electrical current.

aufs — Unit of measurement when using high performance liquid chromatography techniques. Acronym for absorbance units full scale.

cm — Unit of length. Abbreviation for centimeter. 1 centimeter = 1/100 meter.

cfu — Unit measurement for bacteria. Abbreviation for colony forming units.

Dalton — A.M.U. (Atomic Mass Unit).

°C — Unit of temperature abbreviation for degree Centigrade. $^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$.

°F — Unit of temperature. Abbreviation for degree Fahrenheit. $^{\circ}\text{F} = 9/5 (^{\circ}\text{C} + 32)$.

gph — Unit of water flow. Abbreviation for U.S. gallons per hour.

gpm — Unit of water flow. Abbreviation for U.S. gallons per minute.

grain — Unit of ion-exchange capacity. Also, unit of weight.

g — Unit of weight. Abbreviation for gram. 1 gram = 0.035 ounces.

Hz — Unit of electrical frequency. Abbreviation for Hertz. 1 Hertz = 1 cycle per second.

kg/cm² — Unit of pressure. Abbreviation for kilogram per square centimeter. $1 \text{ kg/cm}^2 = 14.2$ pounds per square inch.

Kg — Unit of weight. 1 kg = 2.2 pounds.

kPa — Unit of pressure. Abbreviation for kilo-Pascal. 1kPa = 0.145 pounds per square inch.

l — Unit of volume. Abbreviation for liter. 1 liter = 0.26 U.S. gallon.

lph — Unit of water flow. Abbreviation for liters per hour. 1 liter per hour = 0.26 gph.

lpm — Unit of water flow. Abbreviation for liters per minute. 1 liter per minute = 0.26 gpm.

megohm-cm — Unit of specific resistance of water. 1 megohm-cm = 1,000,000 ohm-cm.

meter — Unit of length. 1 meter = 39.37 inches.

mho/cm — Unit of specific conductance of water.

µm — Unit of length. Abbreviation for micrometer. 1 micrometer = 1/1,000,000 meter.

µg — Unit of weight. Abbreviation for microgram. 1 microgram = 1/1,000,000 gram.

µmho/cm — Unit of specific conductance of water. Abbreviation for micromho/cm. 1 micromho/cm = 1/1,000,000 ohm-cm.

micron — Unit of length. 1 micron = 1/1,000,000 meter.

µs/cm — Unit of specific conductance of water. Abbreviation of microSiemen/cm. 1 micro/Siemen/cm = 1/1,000,000 mho/cm.

mg — Unit of weight. Abbreviation for milligram. 1 milligram = 1/1,000 gram.

ml — Unit of volume. Abbreviation for milliliter. 1 milliliter = 1/1,000 liter.

mm — Unit of length. Abbreviation for millimeter. 1 millimeter = 1/1,000 meter.

ng — Unit of weight. Abbreviation for nanogram. 1 nanogram = 1/1,000,000,000 gram.

NPT — Abbreviation for National Pipe Thread.

NTU — Unit of turbidity. Abbreviation for Nephelometric Turbidity Unit.

ohm-cm — Unit of specific resistance of water.

ppb — Unit of concentration. Abbreviation for parts per billion. 1 part per billion = 1 microgram per liter.

ppm — Unit of concentration. Abbreviation for parts per million. 1 part per million = 1 milligram per liter.

ppm-days — Unit of total chemical exposure. Abbreviation for the multiplicative product of parts per million concentration multiplied by the number of days exposure to that concentration. 2 ppm-days = 2 ppm for 1 day or 1 ppm for 2 days.

psi — Unit of pressure. Abbreviation for pounds per square inch.

S/cm — Unit of specific conductance of water. Abbreviation for Siemens per centimeter. 1 Siemen/cm. = 1 mho/cm.

TDS — Abbreviation for total dissolved solids.

TIS — Abbreviation for total ionized solids.

VAC — Abbreviation for volts, alternating current.

Glossary

CONVERSIONS

Barnstead|Thermolyne

CONVERSION CHART

Conductivity Micromhos-cm. @25°C	Resistivity Ohms-cm. @25°C	Dissolved Solids Parts per Million (ppm)	Approximate Grains/Gallon (GPG) as CaCO ₃
0.056	18,000,000	0.0277	0.00164
0.059	17,000,000	0.0294	0.00170
0.063	16,000,000	0.0313	0.00181
0.067	15,000,000	0.0333	0.00193
0.072	14,000,000	0.0357	0.00211
0.077	13,000,000	0.0384	0.00222
0.084	12,000,000	0.0417	0.00240
0.091	11,000,000	0.0455	0.00263
0.100	10,000,000	0.0500	0.00292
0.111	9,000,000	0.0556	0.00322
0.125	8,000,000	0.0625	0.00368
0.143	7,000,000	0.0714	0.00415
0.167	6,000,000	0.0833	0.00485
0.200	5,000,000	0.100	0.00585
0.250	4,000,000	0.125	0.00731
0.333	3,000,000	0.167	0.00971
0.500	2,000,000	0.250	0.0146
1.00	1,000,000	0.500	0.0292
1.11	900,000	0.556	0.0322
1.25	800,000	0.625	0.0368
1.43	700,000	0.714	0.0415
1.67	600,000	0.833	0.0485
2.00	500,000	1.00	0.0585
2.50	400,000	1.25	0.0731
3.33	300,000	1.67	0.0971
5.00	200,000	2.50	0.146
10.0	100,000	5.00	0.292
11.1	90,000	5.56	0.322
12.5	80,000	6.25	0.368
14.3	70,000	7.14	0.415
16.7	60,000	8.33	0.485
20.0	50,000	10.0	0.585
25.0	40,000	12.5	0.731
33.3	30,000	16.7	0.971
50.0	20,000	25.0	1.46
100.0	10,000	50.0	2.92
111	9,000	55.6	3.22
125	8,000	62.5	3.68
143	7,000	71.4	4.15
167	6,000	83.3	4.85
200	5,000	100	5.85
250	4,000	125	7.31
333	3,000	167	9.71
500	2,000	250	14.6
1,000	1,000	500	29.2
1,110	900	556	32.2
1,250	800	625	36.8
1,430	700	714	41.5
1,670	600	833	48.5
2,000	500	1,000	58.5
2,500	400	1,250	73.1
3,330	300	1,670	97.1
5,000	200	2,500	146
10,000	100	5,000	292

COMMONLY USED CONVERSIONS FOR PURE WATER

VOLUME			
1 U.S. Gallon (gal)	=	231 Cubic Inches (in ³)	
1 U.S. Gallon (gal)	=	3.785 Liters (l)	
1 Cubic Foot (ft ³)	=	7.48 U.S. Gallons (gal)	
1 Cubic Foot (ft ³)	=	1728 Cubic Inches (in ³)	
1 Cubic Meter (m ³)	=	35.3 Cubic Feet (ft ³)	
1 U.S. Ounce (oz)	=	29.57 Milliliters (ml)	
DENSITY			
1 U.S. Gallon (gal)	=	8.33 Lb. Water	
1 Cubic Foot (ft ³)	=	62.3 Lb. Water	
TEMPERATURE		ABSOLUTE TEMPERATURE	
°F	=	(°C X 9/5) + 32	°K = °C + 273
°C	=	(°F - 32) x 5/9	°R = °F + 460
MASS			
1 Lb.	=	453.6 Grams (g.)	= 0.4536 Kilograms (Kg)
1 Lb.	=	7000 Grains (gr.)	
1 Kg	=	2,205 Lb.	
PRESSURE			
1 Atmosphere	=	14.7 Pounds Per Square Inch (psi)	
1 Atmosphere	=	101.325 Kilo Pascal (KPa)	
psia (absolute)	=	psig (gauge) + 14.7	
14.7 psi	=	29.92 Inches Hg	
9.92 In. Hg	=	33.83 Ft. H ₂ O	
1 Kg/cm ²	=	14.223 psi	
1 K Pa	=	0.145 psi	
TOTAL DISSOLVED SOLIDS CONCENTRATION			
1 Grains Per Gallon (gr/gal)	=	17.1 Parts Per Million (ppm)	
1 Grains Per Gallon as NaCl	=	0.85 Grains Per Gallon as CaCO ₃	
1 Part Per Million (ppm)	=	1 Milligram Per Liter (mg/l)	
1 ppm as NaCl	=	0.85 ppm as CaCO ₃	
1 ppm	=	1,000 Parts Per Billion (ppb) =	
		1,000,000 Parts Per Trillion (ppt)	
1 ppb	=	1 Microgram Per Liter (µg/l)	
RESISTIVITY/CONDUCTIVITY			
ohm-cm	=	$\frac{1}{\text{mho/cm}}$	= 1 Siemens/cm
megohm-cm	=	1,000,000 ohms	
megohm-cm	=	$\frac{1}{\text{micromhos/cm}}$	= 1 microSiemens/cm
COMMONLY USED CALCULATIONS FOR PURE WATER			
ION EXCHANGE CAPACITY			
Cartridge Grain Capacity	=	Gallons Processed	
Total Dissolved Solids (Grains/Gal)			
Cartridge Grain Capacity x 17.1	=	Gallons Processed	
Total Dissolved Solids (ppm)			
Cartridge Grain Capacity x 64.7	=	Liters Processed	
Total Dissolved Solids (ppm)			