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Standard Terminology Relating to Biotechnology[1]

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1. Scope

1.1 This document is composed of terms, definitions of terms, descriptions of terms, and acronyms used in ASTM documents related to the field of biotechnology. Terms that are adequately defined in a general dictionary are not defined in this terminology standard.

1.2 This standard includes terminology used in biotechnology areas, such as, but not limited to: biological drug products, materials for biotechnology, characterization and identification of biological systems, aseptic sampling, preservation of biological samples, membrane filters, molecular biology, biomass conversion, fuel manufacturing facilities, and fuel analysis.

2. Referenced Documents

2.1 *ASTM Standards:*

E 869 Test Method for Performance Evaluation of Fuel Ethanol Manufacturing Facilities[2]

E 870 Test Method for Analysis of Wood Fuels[2]

E 1117 Practice for Design of Fuel-Alcohol Manufacturing Facilities[2]

E 1126 Terminology Relating to Biomass Fuels[2]

E 1285 Guide for Identification of Bacteriophage Lambda (λ) or Its DNA[2]

E 1286 Guide for Identification of Herpes Simplex Virus or its DNA[2]

E 1287 Practice for Aseptic Sampling of Biological Materials[2]

E 1298 Guide for Determination of Purity, Impurities, and Contaminants in Biological Drug Products[2]

E 1342 Practice for Preservation by Freezing, Freeze-Drying, and Low Temperature Maintenance of Bacteria, Fungi, Protista, Viruses, Genetic Elements, and Animal and Plant Tissues[2]

E 1344 Guide for Evaluation of Fuel Ethanol Manufacturing Facilities[2]

E 1357 Test Method for Determining the Rate of Bleaching of Iron From Pyrite by Thiobacillus Ferrooxidans[2]

E 1493 Guide for Identification of Bacteriophage M13 or Its DNA[2]

E 1531 Practice for Detection of Mycoplasma of Cell Cultures by Growth on Agrose Medium[2]

E 1532 Practice for Detection of Mycoplasma Contamination of Cell Cultures by Use of the Bisbenzamide DNA-Binding Fluorochrome[2]

E 1533 Practice for Indirect Detection of Mycoplasma in Cell Culture by 4′-6-Diamidino-2-2 Phenylindole (DAPI) Staining[2]

E 1535 Test Method for Performance Evaluation of Anaerobic Digestion Systems[2]

E 1536 Practice for Detection of Mycoplasma Contamination of Bovine Serum by Large Volume Method[2]

E 1564 Guide for Design and Maintenance of Low-Temperature Storage Facilities for Maintaining Cryopreserved Biological Materials[2]

E 1565 Guide for Inventory Control and Handling of Biological Material Maintained at Low Temperatures[2]

E 1566 Guide for Handling Hazardous Biological Materials in Liquid Nitrogen[2]

E 1567 Guide for Biopharmaceutical Facilities Architectural Design Considerations[2]

2.2 *Federal Standards:*

Title 21, Code of Federal Regulations (CFR), Parts 210 and 211[3]

3. Terminology

3.1 *Definitions:*

accessible—permitting close approach or contact that could include requiring removal or opening of an access panel or door. **E 1117**

aerobic—able to live, grow, or take place only where free oxygen is present. **E 1126**

aerobic fermentation—fermentation processes that require the presence of air. **E 1126**

alcohols—series of liquid products composed of a hydrocarbon plus a hydroxyl group, such as ethanol (C_2H_5OH). **E 1344**

alpha-amylase—enzyme that acts specifically to accelerate the hydrolysis of starch to dextrins. **E 1344**

alpha complementation—the ability of a short amino-terminal fragment (alpha fragment) of β-galactosidase to

[1] This terminology is under the jurisdiction of ASTM Committee E48 on Biotechnology and is the direct responsibility of Subcommittee E48.91 on Terminology.

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[2] *Annual Book of ASTM Standards*, Vol 11.05.

[3] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

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form a functional complex with the carboxyl terminal fragment (omega fragment). **E 1493**

anaerobic—living or active in an airless environment. **E 1126**

anaerobic bacteria—microbes whose metabolisms require the absence of free oxygen. **E 1126**

anaerobic digester—a chemical reactor in which anaerobic bacteria are used to decompose biomass or organic wastes to produce methane and carbon dioxide. **E 1126**

anaerobic digestion—degradation of organic matter by microbes in the absence of air (oxygen) to produce methane and carbon dioxide (biogas). **E 1126**

anaerobic fermentation—fermentation processes conducted in the absence of air. The following anaerobic fermentation processes are significant in obtaining useful forms of energy from biomass: (*1*) alcoholic fermentation, fermentation processes whereby certain microorganisms convert glucose and other substrates with alcohol as an end product, (*2*) methane fermentation, generally termed anaerobic digestion (See also **anaerobic digestion**). **E 1126**

anhydrous—a material that does not contain water either absorbed on its surface or as water of crystallization; a water-free product. **E 1126**

anhydrous ethanol—100 % ethanol, neat ethanol, 199 + proof ethanol. **E 1344**

anhydrous, without water—term used in chemistry to denote absence of water. 199 + proof ethanol is considered anhydrous ethanol. **E 1344**

aseptic sampling—sampling process in which no extraneous microorganisms or substances are introduced into the sample or its original bulk material as a result of the sampling system and activity. **E 1287**

ash—inorganic residue remaining after combustion, determined by definite prescribed methods. **E 1126**

ash fusion temperature—melting point of ash, usually expressed in degrees Fahrenheit. Variations include oxidizing atmosphere or reducing atmosphere, initial softening, or final fluid temperature. Some specifications include two intermediate points between initial softening and final fluid. **E 1126**

azeotrope—constant boiling mixture, for ethanol-water, the azeotrope of 95.6 % ethanol and 4.4 % water (both percentages by volume) boils at one atmosphere pressure. **E 1344**

azeotropic distillation—the use of an organic solvent to create a new constant boiling point mixture, a method used to produce anhydrous ethanol from the ethanol water azeotrope. **E 1344**

backset—the liquid portion of the thin stillage that is recycled as part of the process liquid in mash preparation. **E 1344**

bacteriophage—a virus that infects bacteria. **E 1285**

bagasse—residue remaining after extraction of a sugar-containing juice from plants like sugar cane. **E 1126**

basic hydrolysis—the chemical addition of water to a compound. **E 1344**

batch fermentation—batch of nutrient mixture and microorganisms mixed in a vessel and allowed to ferment. **E 1344**

beer—term used to describe the product of ethanol fermentation by microorganisms. **E 1344**

bioconversion—a general term describing the use of biological systems to transform one compound into another. Examples are digestion of organic wastes or sewage by microorganisms to produce methane. **E 1126**

biofuel—biomass-derived fuel. **E 1126**

biogas—a composition of methane and carbon dioxide and minor constituents produced by the digestion of organic substrates in the absence of oxygen. **E 1535**

biomass—total weight of living matter in a given volume. When considered as an energy source, biomass is further subdivided into: (*1*) primary biomass, rapidly growing plant material that may be used directly or after a conversion process for the production of energy, and (*2*) secondary biomass, biomass residues remaining after the production of fiber, food, or other products of agriculture, or biomass by-products from animal husbandry or food preparation that are modified physically rather than chemically. Examples include waste materials from agriculture and forestry industries (manure, sewage, etc.) from which energy may be produced. The above distinction noted between primary and secondary biomass is based on economic factors; these are defined differently in ecological science. **E 1126**

biomass—any material, excluding fossil fuels, which is or was a living organism that can be used as a fuel directly or after a conversion process. Peat is not a biomass. **E 1126**

biomass fuel—fuel derived from biomass. **E 1126**

capsomere—a structural subunit of the outer protein shell (capsid) of a virus consisting of protein monomers. **E 1286**

carbohydrates—molecules consisting of carbon, hydrogen and oxygen that include celluloses, starches and sugars. **E 1344**

centrifuge—machine that separates a mixture of solids and liquids by centrifugal force. **E 1344**

contaminants—all adventitious substances or microorganisms present in raw materials, bulk drugs, or final products. **E 1298**

continuous fermentation—nonstop flow of nutrients into a fermenting vessel, with the simultaneous outflow of products, organisms, and by-products. **E 1344**

conversion efficiency—the ratio of the actual to theoretical fuel ethanol yield per unit mass of the feedstock. **E 1344**

corn stover—the stalks of the maize plant. **E 1126**

cryogenic temperatures—for purposes of this practice, cryogenic temperatures are temperatures at or below − 70°C. **E 1342**

cryogenic temperatures—temperatures below or equal to − 100°C. **E 1564, E 1565, E 1566**

cryoprotectant—a chemical substance used to protect cells during freezing and rewarming. **E 1342**

current good manufacturing practices (CGMP)—current regulations published by the United States Food and Drug Administration (FDA) regarding manufacturing, processing, packaging and storing of drug and biological products. **E 1287**

cycle time—the time required by an alcohol plant to complete one cycle. **E 869**

dead leg—any inactive, trapped or stagnant zone of a biological fluid that is to be sampled aseptically where this liquid zone would not be representative of the bulk fluid that is to be sampled. This "dead leg" zone could deviate from the bulk system in oxygen content, nutrients levels, material composition, temperature, bacterial contamination, and other process variables that would prevent any sample drawn through this system from representating the bulk fluid quality to be tested. **E 1287**

deleterious impurities—impurities that might be a health or safety concern, particularly with respect to toxicity, carcinogenicity, or immunogenicity. Deleterious impurities must be controlled and their levels determined using suitable analytical methods. **E 1298**

denaturant—toxins or noxious materials added to ethanol to make it unfit for human consumption. **E 1344**

denatured ethanol—ethanol that is mixed with other chemicals or denaturants to make it unsuitable for human consumption. **E 1344**

denatured fuel ethanol—fuel ethanol to which chemicals (denaturants) have been added to make the ethanol unfit for human consumption in accordance with the regulations of the Bureau of Alcohol, Tobacco, and Firearms of the U.S. Treasury Department. **E 1126**

densified particulate biomass fuels—a fuel made by mechanical compression of biomass to increase the bulk density and to press the fuel into a specific shape, such as pellets and briquettes. The fuel can have a maximum volume of 16.39 cm^3(1 $in.^3$) such that the largest dimension is 7.62 cm (3 in.). **E 1126**

dextrins—high molecular weight sugars, intermediates obtained in the conversion of starch to fermentable sugar. **E 1344**

digester—a bioreactor in which anaerobic bacteria are used to decompose biomass or organic wastes into methane and carbon dioxide. **E 1126**

direct detection of mycoplasma—detection of mycoplasma by cultivation in culture media. **E 1531, E 1532, E 1533, E 1536**

distillate—the overhead product of distillation such as ethanol liquid from the top of a beer still. **E 1344**

distillation—the act of vaporizing and condensing a liquid in sequential steps to effect separation from a liquid mixture. **E 1344**

distillers grains—the insoluble solids that have been separated from the stillage bottoms or beer. Moisture content may range from 60 to 85 %, depending upon the level of dewatering during separation. **E 1344**

DNA fluorochrome stain—staining of DNA specifically by the use of bisbenzamide fluorochrome stain[4] or other DNA fluorochromes of comparable quality and performance, such as DAPI (4′,6-diamidine-2-phenyl-indole-2HCl)-Serva 18860. **E 1532**

dry basis moisture content—of biomass fuels, the ratio of the weight of the water in a sample to the weight of the dry material. It is expressed as a percent. **E 1126**

durability—the quality of a component to perform as designed for its design life. **E 1117**

envelope—a layer of cell membrane-derived lipoprotein that surrounds the protein coat (capsid) of some viruses. **E 1286**

enzyme—biological catalyst that is protein in nature. **E 1344**

ethanol—ethyl alcohol, the chemical compound C_2H_5OH, a two carbon alcohol. **E 1344**

ethanol (ethyl alcohol, grain alcohol)—CH_3CH_2OH; can be produced chemically from ethylene or biologically from the fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. **E 1126**

eutectic temperature—the temperature below which all liquid portions of an aqueous suspension have entered the solid phase. **E 1342**

extreme weather conditions—environmental conditions that have occurred only once during the past 30 years. **E 1117**

feedstock—the base raw material that is the source of carbohydrate, such as starch, for producing sugars that can be fermented into alcohol and carbon dioxide. **E 1344**

fermentation—decomposition of organic compounds, by microorganisms, to fuels and chemicals such as alcohols, acids, and energy-rich gases. **E 1126**

fermentation—the biochemical reaction process where microorganisms in a nutrient medium convert a feedstock to a product. **E 1344**

fermentation fuel—a fuel produced by fermentation of biomass. **E 1126**

F factor—an episome of *E. coli*. Encoded on it are the functions necessary to produce an F pilus. **E 1493**

fixed carbon—carbon remaining after heating in a prescribed manner to decompose thermally unstable components and to distill volatiles. **E 1126**

flash point—the temperature at which a combustible liquid ignites. **E 1344**

F pilus—a protrusion on *E. coli* that is necessary for mating. The F pilus also contains the receptor for phage M13. **E 1493**

freeze-drying—sublimation of water from a frozen aqueous suspension. **E 1342**

freezing—lowering the temperature of an aqueous suspension to a point at or below the temperature of ice crystal formation. **E 1342**

fuel alcohol—ethyl, methyl, or higher alcohols with impurities (including water but excluding denaturants) produced for use as a fuel alone or as an addition to other fuels, such as gasoline. **E 1126**

fuel ethanol—ethanol with impurities (including water but excluding denaturants). **E 1126**

fuel ethanol manufacturing facility—a manufacturing facility of any size designed to produce fuel ethanol by a fermentation process. **E 1126**

furfural—an aldehyde derivative of certain biomass conversion processes, used as a solvent. **E 1126**

fuse oils—complex group of higher molecular weight materials including ketones and aldehydes produced as a byproduct by the yeast fermentation during ethanol production.

[4] Available from Calbiochem, P.O. Box 12087, San Diego, CA 92112-4180.

E 1344

fusel oil—a clear, colorless, poisonous, liquid mixture of alcohols obtained as a by-product of grain fermentation; generally amyl, isoamyl, propyl, isopropyl, butyl, and isobutyl alcohols and acetic and lactic acids. **E 1126**

gasification—any chemical or heat process used to convert a feedstock to a gaseous fuel. **E 1126**

gasifier—a device that converts solid fuel to gas. Generally refers to thermochemical processes. Major types are moving bed (fixed bed), entrained bed, and fluidized bed. **E 1126**

gelatinization—treatment of starch grains with heat and water to cause the swelling and expansion of the starting material. **E 1344**

genome (of a virus)—the genetic material consisting of nucleic acid (RNA or DNA). **E 1286**

glucoamylase—enzyme that acts specifically to convert dextrins to glucose by hydrolysis. **E 1344**

glucose—the most prominent simple sugar (6-membered $C_6H_{12}O_6$) produced from starches and cellulose material by hydrolysis. **E 1344**

good engineering practices—include design practices and criteria accepted in professional societies (ASTM, AIChE, ASME, ACS, etc.), proved by experience, verified by actual data, etc., that will meet the process, safety, and environmental requirements of the system. **E 1117**

hazardous biological materials—living biological materials, and products derived therefrom, that pose a potential threat to human health. **E 1566**

herbaceous plants—nonwoody species of vegetation, usually of low lignin content such as grasses. **E 1126**

hogged fuel—ground wood fuel that is usually a by-product of a wood products manufacturing process. **E 1126**

hydrolysis—the act of cleaving or splitting of complex molecules by the chemical addition of a water molecule. Acid hydrolysis is defined as the chemical addition of water to a compound such as starch in the presence of an acid as a catalyst that will form another compound such as glucose. **E 1344**

impurities, of a biological drug product—all process-related (nonadventitious) substances present in the raw materials, bulk drug, or final drug product that are not considered to be the active material, additives, or excipients. **E 1298**

indirect detection of mycoplasma—detection of mycoplasma by DNA staining or any method other than cultivation. **E 1531, E 1532, E 1533, E 1536**

induction—the relief of repression of transcription of lysogenic phage genes encoding the functions for lytic growth, so that the phage will grow lytically. **E 1285**

innocuous impurities—impurities that are not a health or safety concern in the product. The route of administration of the drug may be a significant criterion in the determination of whether an impurity is innocuous. **E 1298**

landfill gas—biogas produced from the natural degradation of the organic material in landfills. **E 1126**

large volume testing—using a large volume of the material to be tested as an inoculum in direct detection of mycoplasma. **E 1536**

lignin—the noncarbohydrate, polyphenolic, structural constituent of wood and some other plant tissues that encrusts the cell walls and cements the cells together. **E 1126**

liquid nitrogen freezers—freezers that operate by a refrigeration system in which cooling is provided by a refrigerant such as liquid nitrogen. **E 1565**

liquid nitrogen storage—storage directly in liquid nitrogen or in the vapor phase above liquid nitrogen. **E 1566**

low temperature preservation—stabilizing viable or biologically active material by freezing or freeze-drying. **E 1342**

lysogen—a bacterial strain that has a phage stably maintained. In the case of lambda, the phage is integrated into the host genome. The integrated phage is called a prophage. **E 1285**

mash—the mixture of sugars, nutrients, and water that is capable of being fermented by microorganisms such as yeast in ethanol fermentation. **E 1344**

mechanical freezers—freezers that operate by a refrigeration system in which cooling is provided by mechanical means such as a compressor. **E 1565**

mechanical refrigeration—a refrigeration system in which cooling is provided by mechanical means such as a compressor. **E 1564**

methanogenic bacteria—microorganisms capable of producing methane. **E 1126**

methanol (methyl alcohol, wood alcohol)—an alcohol, CH_3OH, formed by catalytically combining carbon monoxide (CO) with hydrogen (H_2) in a 1:2 ratio, under high temperature and pressure. Commercially, it is often manufactured by steam reforming natural gas. It is also formed in the destructive distillation of wood. **E 1126**

moisture content—the amount of water contained in the biomass, expressed as either a percentage of the mass of the oven-dry biomass or of the wet biomass, moisture content, dry basis. **E 1126**

multiple cloning site—DNA that contains several contiguous restriction enzyme recognition sites; also called a polylinker. **E 1493**

multiplicity of infection—the ratio of infecting phage to host bacteria. **E 1285**

municipal solid wastes (MSW)—the refuse materials collected from urban areas in the form of organic matter, glass, plastics, waste paper, etc., not including human wastes. **E 1126**

mycoplasma—the smallest prokaryotes capable of living freely, lacking a cell wall, having a circular double-stranded DNA relatively rich in adenine and thymine, and containing 16s and 23s ribosomal RNAs. They can be found as contaminants in cell cultures. **E 1531, E 1532, E 1533, E 1536**

normal weather conditions—the range of environmental conditions in a local climatic region that occurred during the past 30 years. This excludes extreme conditions that have occurred only once during that period. **E 1117**

nucleocapsid—the outer protein coat or shell (capsid) of a virus plus its inner core of nucleic acid and proteins. **E 1286**

normal operating conditions—the usual range of physical operating conditions (flow, pressure, temperature, etc.) for

component or system. **E 1117**

normal operating conditions—the usual range of physical conditions for which a facility was designed to operate. **E 869**

packed distillation column—a column or tube constructed with internals of ceramic, steel, or fiberglass-type materials to separate one or more volatile liquids by distillation. **E 1344**

particulate wood fuel—any wood fuel with a maximum particle volume of 16.39 cm^3(1 $in.^3$) such that the largest dimension is 7.62 cm (3 in.). **E 1126**

passive refrigeration—a refrigeration system in which cooling is provided by a refrigerant such as liquid nitrogen. **E 1564**

pathogenic—disease causing. **E 1287**

pelletized biomass fuel—see **densified particulate biomass fuels.** **E 1126**

plaque—a round, clear area in a layer of host cells caused by virus growth and resultant killing or lysis of the cells. **E 1286**

plate distillation column—column constructed with perforated plates to separate one or more volatile liquids by distillation. **E 1344**

press—mechanical device that removes liquids from solids by mechanically pressing the solids against a porous surface. **E 1344**

production cycle—the series of operations required to process through the facility a quantity of feedstock mixed with water having a volume equal to the typical volume of the fermentation system and return the facility to the configuration at the start of the cycle. The quantity of water mixed with the feedstock shall be as per specification for normal operation. This volume is equal to the sum of the working volumes of all fermenters in a batch fermentation process. This volume is equal to the sum of the working volumes of each stage of fermentation in a continuous fermentation process. **E 869**

proof—measurement term of concentration of ethanol in water solutions. **E 1344**

protein—general term used to cover single cell microorganisms, extract of the microorganisms, (bacteria or fungi or algae) that is used for food or feed to animals and humans. **E 1344**

proximate analysis—the determination, by prescribed methods, of moisture, volatile matter, fixed carbon (by difference), and ash. The term **proximate analysis** does not include determinations of chemical elements or determinations other than those named. **E 1126**

proximate analysis—an assay of the moisture, ash, volatile matter, and fixed carbon as determined by prescribed test methods. Other constituents such as sulfur and phosphorus are not included. **E 870**

purity, of a biological drug product—the measure of the biologically active drug in relation to the total substances (not including additives) present in the drug product, usually expressed on a percentage basis. **E 1298**

pyrolysis—the breaking apart of complex molecules by heating (over the range from 392° to 932° (200° to 500°C)) in the absence of oxygen, producing solid, liquid, and gaseous fuels. **E 1126**

quad—one quadrillion (10^{15}) Btu. **E 1126**

reflux, in distillation processes—reflux is the liquid condensate recycle to the top of a distillation column to aid in purification of the overhead product (ethanol). **E 1344**

refuse-derived fuel (RDF)—fuel processed from industrial waste, municipal waste, garbage, or sewage sludge. **E 1126**

refuse derived fuel 3 (RDF-3)—as defined by Committee E-38 on Resource Recovery, RDF-3 is a shredded fuel derived from municipal solid waste (MSW) that has been processed to remove metal, glass, and other inorganics. The material has a particle size such that 95 % weight passes through a 2 in. square mesh screen. **E 1126**

renewable energy resources—sources of energy that are regenerative or virtually inexhaustible, such as solar, wind, ocean, biomass, municipal wastes, and hydropower energy. Geothermal energy is sometimes also included in the term. **E 1126**

restriction endonuclease—a bacterial enzyme that cuts double-stranded DNA at positions consisting of specific short sequences of nucleotides. **E 1286**

saccharification—the breaking of dextrins (starch) into simple sugars (hydrolysis). **E 1344**

solids—two types of solids are present in mash. First, insoluble solids are present as solid matter present in the liquid portion of the mash. Secondly, soluble solids are dissolved in the liquid portion of the mash. **E 1344**

sterile—free of any living organism. **E 1287**

stillage—the liquid products or waste remaining after distillation of a beer. The soluble residue are water, proteins, etc. **E 1344**

stover—the dried stalks and leaves of a crop remaining after the grain has been harvested. **E 1126**

sugars—molecules of carbohydrate, namely monosaccharides and disaccharides such as glucose, galactose, mannase, sucrose or fructose, etc. **E 1344**

supernatant—that liquid remaining after separation of a liquid/solid mixture. **E 1344**

syngas—the synthetic gas resulting from incomplete combustion or pyrolysis of organic material to primarily carbon monoxide and hydrogen. (See also **synthesis gas**.) **E 1126**

synthesis gas—mixtures of gas in suitable proportions for the production of synthetic products without adding further reactants, such as carbon monoxide and hydrogen, for synthesis of methanol. **E 1126**

temperate bacteriophage—a bacteriophage that can grow lytically, killing the host, or can exist stably in the host. **E 1285**

total weight basis moisture content—of biomass fuels, the ratio of the weight of the water in a sample to the weight of the wet material. It is expressed as a percent (also called wet basis moisture content). **E 1126**

ultimate analysis—the determination of carbon and hydrogen in the material, as found in the gaseous products of its complete combustion, the determination of sulfur, nitrogen, and ash in the material as a whole, and the calculation of oxygen by difference. **E 870**

ultimate analysis—the determination of the elemental composition of the organic portion of carbonaceous materials as well as the total ash and moisture. Determined by prescribed methods. **E 1126**

vacuum distillation—to affect separation of two or more liquids under reduced pressure operation of a distillation column. Vacuum reduces the boiling points of the liquids being separated. **E 1344**

vacuum distillation—the separation of two or more liquids under reduced vapor pressure; reduces the boiling points of liquids being separate. **E 1126**

validation—the quality assurance evaluation of an item of equipment or overall process wherein the equipment or process, or both, is challenged to perform under the "worst case" conditions of process variables and applicable microorganism contamination to meet preestablished acceptance criteria. **E 1287**

vector—a fragment of DNA usually containing an origin of replication that is engineered to accept a foreign piece of DNA. **E 1285**

vitrification—solidification of an aqueous suspension at low temperatures without the formation of ice crystals. **E 1342**

volatile matter—those products, exclusive of moisture, given off by a material as gas or vapor, determined by definite prescribed methods that may vary according to the nature of the material. **E 1126**

wet-basis moisture content—the moisture content expressed as the ratio of the weight of water in the fuel to the total weight of the fuel. **E 1126**

wet basis moisture content—see **total weight basis moisture content**. **E 1126**

wild type—the naturally occurring, original isolate. **E 1285**

wood fuel—fuel derived from biomass composed of woody trees or shrubs. **E 1126**

yeast—single cell microorganisms (fungi) that produce alcohol and CO_2 under normal fermentation conditions. **E 1344**

3.2 *Descriptions of Terms:*

soluble iron—the determination of "soluble iron" used in this test method corresponds operationally to the "complexed and dissolved" iron determination described by Vuorinen et al.[5] in their study of the species of iron released from pyrite oxidation by *T. ferrooxidans*. They found that values of complexed and dissolved iron corresponded closely with "total iron" as determined after hot sulfuric acid digestion of samples, particularly at 1 to 2 % pulp density. **E 1357**

3.3 *Acronyms:Acronyms:*

BTU—one British Thermal Unit is the amount of heat required to raise 1 lb of water 1°F. **E 1344**

cGMP—abbreviation for current good manufacturing practices as defined in CFR Title 21, Parts 210 and 211. **E 1567**

DAPI staining—staining of DNA in particular by using DAPI fluorochrome stain (Serva 18860). **E 1533**

F—an F factor that contains a portion of the *E. coli* genome. **E 1493**

FEMF—Fuel Ethanol Manufacturing Facility. **E 1344**

pH—the measurement of the acid concentration of a solution. Range is 0 to 14 (acid to basic), with pH 7 being neutral. **E 1344**

[5] Vuorinen, A., Hiltunen, P., Hsu, J.C., and Tuovinen, O.H., "Solubilization and Speciation of Iron During Pyrite Oxidation by *Thiobacillus ferroxidans," Geomicrobiology Journal*, Vol 3, 1983, pp. 95–120.

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