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An American National Standard

Standard Terminology for Metalworking Fluids and Operations[1]

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1. Scope*

1.1 This terminology standard provides a compilation of ASTM and non-ASTM consensus definitions of terms used in the metalworking industry.

1.2 This terminology standard does not purport to be an exhaustive lexicon. Rather, it defines terms relevant to metalworking fluid management and metalworking fluid health and safety.

1.3 This terminology standard defines primary metalworking operations, fluid types, and other terms germane to the practice of metalworking fluid management.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

D2881 Classification for Metalworking Fluids and Related Materials

D6161 Terminology Used for Microfiltration, Ultrafiltration, Nanofiltration, and Reverse Osmosis Membrane Processes

D7049 Test Method for Metalworking Fluid Aerosol in Workplace Atmospheres

E1302 Guide for Acute Animal Toxicity Testing of Water-Miscible Metalworking Fluids

E1497 Practice for Selection and Safe Use of Water-Miscible and Straight Oil Metal Removal Fluids

E1687 Test Method for Determining Carcinogenic Potential of Virgin Base Oils in Metalworking Fluids

E1972 Practice for Minimizing Effects of Aerosols in the Wet Metal Removal Environment (Withdrawn 2017)[3]

E2144 Practice for Personal Sampling and Analysis of Endotoxin in Metalworking Fluid Aerosols in Workplace Atmospheres

E2148 Guide for Using Documents Related to Metalworking or Metal Removal Fluid Health and Safety

E2169 Practice for Selecting Antimicrobial Pesticides for Use in Water-Miscible Metalworking Fluids

E2275 Practice for Evaluating Water-Miscible Metalworking Fluid Bioresistance and Antimicrobial Pesticide Performance

E2563 Practice for Enumeration of Non-Tuberculosis *Mycobacteria* in Aqueous Metalworking Fluids by Plate Count Method

E2564 Practice for Enumeration of *Mycobacteria* in Metalworking Fluids by Direct Microscopic Counting (DMC) Method

E2657 Practice for Determination of Endotoxin Concentrations in Water-Miscible Metalworking Fluids

E2693 Practice for Prevention of Dermatitis in the Wet Metal Removal Fluid Environment

E2694 Test Method for Measurement of Adenosine Triphosphate in Water-Miscible Metalworking Fluids

2.2 *Government Standards:*[4]

29 CFR 1910.1200 Occupational Safety and Health Standards, Hazard Communication

40 CFR 156 Labeling Requirements for Pesticides and Devices

3. Significance and Use

3.1 Personnel from a wide range of disciplines contribute to metalworking fluid management and plant environment health

[1] This terminology is under the jurisdiction of ASTM Committee E34 on Occupational Health and Safety and is the direct responsibility of Subcommittee E34.50 on Health and Safety Standards for Metal Working Fluids.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

*A Summary of Changes section appears at the end of this standard

and safety management. Consequently, terms familiar to some stakeholders will be unfamiliar to others.

3.2 This terminology standard provides, in a single document, a compilation of definitions used by personnel involved with both metalworking environment health and safety and fluid management.

3.3 Use of terms as defined in this terminology standard will enable all stakeholders to use metalworking industry terms in the appropriate context, thereby improving interdisciplinary communications.

4. Terminology

acid-fast bacteria, *n*—a distinctive staining property of *Mycobacteria* due to their lipid-rich cell walls.

DISCUSSION—Once stained, mycobacterium resist decolorization when exposed to acidified organic solvents and are, therefore, informally designated acid-fast. **E2564**

active ingredient (a.i.), *n*—the chemical or components of an antimicrobial pesticide that provides its antimicrobial performance. **E2169, E2275**

acute dermal toxicity, *n*—health hazards likely to arise from short-term exposure to a substance via the skin or mucosa. **E1302**

DISCUSSION—Results of acute dermal toxicity testing may provide initial information on the dermal absorption and the mode of toxic action of a substance. Moreover, some measure of irritation caused by the fluid may be obtained by observing local tissue damage at the site of application. Endpoint: mortality.

acute inhalation toxicity, *n*—the potential of a fluid, vapor, or gas to cause death and other adverse health effects when inhaled for a specified time period. **E1302**

DISCUSSION—The endpoint may be mortality or other specific health effect designated in the test protocol.

acute oral toxicity, *n*—health hazards likely to arise from short-term exposure to a substance via the oral route (ingestion). **E1302**

DISCUSSION—Results of acute oral toxicity tests are used to develop warning statements on labels as may be required by OSHA Hazard Communication Standard 29 CFR 1910.1200 or Federal Hazardous Substances Act. These are also used to establish a dosage regimen for subchronic and other testing. Endpoint: mortality.

adenosine monophosphate (AMP), *n*—the molecule formed by the removal of two molecules of phosphate (one pyrophosphate molecule) from ATP. **E2694**

adenosine triphosphate (ATP), *n*—a molecule comprised of a purine and three phosphate groups that serves as the primary energy transport molecule in all biological cells. **E2694**

aerosol, *n*—a dispersion of solid or liquid particles in a gaseous medium. **D1356**

antimicrobial pesticide, *n*—chemical additive registered under 40 CFR 156, for use to inhibit growth, proliferation, or both of microorganisms. **E2169, E2275**

DISCUSSION—Antimicrobial pesticides are registered for one or more end-use applications, or sites, for use within an approved dose range.

aseptic, *adj*—sterile, free from viable microbial contamination. **E2694**

as supplied (a.s.), *adj*—antimicrobial pesticide finished product including the active ingredients, solvent, and any additional inactive ingredients. **E2275**

background RLU, *n*—the quantity of relative light units resulting from running the Method without incorporation of the sample. **E2694**

bactericide, *n*—an antimicrobial pesticide specifically or primarily effective against bacteria. **E2169**

bioburden, *n*—the level of microbial contamination (biomass) in a system. **E2169**

DISCUSSION—Typically, bioburden is defined in terms of either biomass or numbers of cells per unit volume or mass or surface area material tested (g biomass/mL; g biomass/g sample; cells/mL sample; colony forming units (CFU)/mL sample and so forth).

biocide, *n*—any chemical intended for use to kill organisms. **E2169, E2275**

DISCUSSION—Biocide is a term usually used synonymously with the preferred *antimicrobial pesticide* or *microbicide*.

biodeterioration, *n*—the loss of commercial value, performance characteristics, or both of a product (metalworking fluid) or material (coolant system or finished parts) through biological processes. **E2169**

biofilm, *n*—a film or layer composed of microorganisms, biopolymers, water, entrained organic and inorganic debris that forms as a result of microbial growth, proliferation, and excretion of polymeric substances at phase interfaces (liquid-liquid, liquid-solid, liquid-gas, and so forth). (synonym: *skinnogen layer*). **E2169**

bioluminescence, *n*—the production and emission of light by a living organism as the result of a chemical reaction during which chemical energy is converted to light energy. **E2694**

biomass, *n*—any matter which is or was a living organism or excreted from a microorganism. **D6161**

bioresistant, *adj*—ability to withstand biological attack. **E2169, E2275**

DISCUSSION—Bioresistant, or recalcitrant, chemicals are not readily metabolized by microorganisms.

biostatic, *adj*—able to prevent existing microbial contaminants from growing or proliferating, but unable to kill them. **E2169, E2275**

DISCUSSION—Biostatic additives may be registered antimicrobial pesticides or unregistered chemicals with other performance properties. The difference between biocidal and biostatic performance may be attributed to dose, chemistry, or both.

boring, *v*—enlarging a hole that already has been drilled.

DISCUSSION—Generally, boring is an operation of truing the previously drilled hole with a single-point, lathe-type tool. Boring is essentially internal turning.

breathing zone, *n*—that location in the atmosphere at which persons breathe. **D1356**

DISCUSSION—The worker's breathing zone consists of a hemisphere 300-mm radius in front of the face and measured from a line bisecting the ears. D7049

broaching, *v*—an operation in which a cutter progressively enlarges a slot or hole, or shapes a workpiece exterior.

DISCUSSION—Low teeth start the cut, intermediate teeth remove the majority of the material, and high teeth finish the task. Broaching can be a one-step operation, as opposed to milling and slotting, which require repeated passes. Typically, however, broaching also involves multiple passes.

bubbler, *n*—a sampling device consisting of a gas dispenser immersed in an absorbing liquid. D1356

coining, *v*—a closed-die squeezing operation in which all surfaces of the work are restrained (coined).

DISCUSSION—Coining often imparts a pattern or shape onto the workpiece. Coining also refers to a press-brake bending operation in which the punch bottoms against the workpiece and the die. It also refers to a process similar to bottoming although greater force is applied. Coining alters the radius, and bottoming sets the bend open but does not affect shape.

collector, *n*—a device for removing and retaining contaminants from air or other gases. D1356

contaminant, *n*—substances contained in in-use metalworking fluids that are not part of the received fluid, such as abrasive particles, tramp oils, cleaners, dirt, metal fines and shavings, dissolved metal and hard water salts, bacteria, fungi and microbiological decay products, and waste. E1497

contamination control, *n*—maintenance of bioburden at an operationally defined level, at or below which the bioburden does not affect the fluid or system adversely. E2169

control, *v*—to prevent, eliminate, or reduce hazards related to the use of metalworking fluids in metalworking processes and to provide appropriate supplemental, or interim protection, or both, as necessary, to employees. E1497

control standard endotoxin (CSE), *n*—a purified preparation of endotoxin based on the USP Reference Standard Endotoxin (RSE); used in laboratories to prepare standard solutions. E2657

coolant, *n*—any liquid used for the purpose of facilitating heat removal from metal removal, forming, or both types of metalworking operations.

DISCUSSION—Coolants are typically classified by the general chemical composition as emulsifiable oils, semi-synthetic oils, straight oils, or synthetic fluid (Classification D2881). See definitions 4.32, 4.72, 4.77 and 4.78, respectively. Coolants are used primarily to cool and lubricate.

culturable, *adj*—microorganisms that proliferate as indicated by the formation of colonies on solid growth media or the development of turbidity in liquid growth media under specific growth conditions. E2694

demand, *n*—the sum of all factors that contribute to decreasing the effective concentration of antimicrobial pesticide. E2169

DISCUSSION—Processes contributing to demand include, but are not limited to, reactions with microbes, reactions with other chemicals in the fluid, adsorption onto surfaces, absorption into materials, and temperature.

dermatitis, *n*—an inflammatory response of the skin. E1497

DISCUSSION—Dermatitis can result from a wide variety of sources and processes. The most common origins are irritants or allergic responses to a chemical or physical agent. Signs and symptoms that typify the initial onset of dermatitis include: erythema (redness); edema (swelling); pruritis (itching); and vesiculation (pimple-like eruptions). In more severe cases, fissures (deep cracks) and ulcers (open sores) may develop. The condition is usually reversible when exposure to the causative agent ceases. More severe cases may require more time and some medical attention. Some individuals may be at higher risk.

dilution ventilation, *n*—referring to the supply and exhaust of air with respect to an area, room, or building, the dilution of contaminated air with uncontaminated air for the purpose of controlling potential health hazards, fire and explosion conditions, odors, and nuisance-type contaminants, from Industrial Ventilation: A Manual of Recommended Practice. E2693

dose, *n*—concentration of antimicrobial pesticide added to treated solution. E2169, E2275

DISCUSSION—Dose is generally expressed as either ppm active ingredient (a.i.) or ppm as supplied (a.s.).

drawing, *v*—process by which a metal blank is forced to flow through a die cavity without any constraint other than against buckling.

DISCUSSION—Internal resistance flow of the metal towards the punch and dies sets up compressive stresses which, combined with tensile stresses created by the motion of the punch, produce two-dimensional shear.

drilling, *v*—operation in which a rotating tool is used to create a round hole in a workpiece.

DISCUSSION—Drilling is normally the first step in machining operations such as boring, reaming, tapping, counterboring, countersinking, and spotfacing.

emergency, *n*—any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that results in an uncontrolled release of a significant amount of metalworking fluid. E1497

employee exposure, *n*—the exposure to metalworking fluids and contaminants which would occur without corrections for protection by any respirator or other personal protective equipment that is in use.

emulsifiable oil (frequently referred to as "soluble oil"), *n*—a metalworking fluid that generally contains >30 % oil before dilution with water. D2881

DISCUSSION—Emulsifiable oils contain emulsifiers and other functional additives and generally create macro-emulsions (average size >1.0 μm) when diluted with water.

DISCUSSION—Emulsifiable oils are blended with water in their end use.

emulsifier, *n*—a surface-active agent, or surfactant, that is at least partially soluble in both liquids (phases) of an emulsion, and thus stabilizes one in the other. D2881

emulsion, *n*—a relatively stable mixture of two immiscible liquids, one of which is held in suspension in the other by small amounts of emulsifiers. D2881

emulsion synthetic fluid, *n*—a metalworking fluid formulation that is prepared from vegetable oil, esters, or other synthetic basestocks; contains emulsifiers and other functional additives but no petroleum oil, and produces an emulsion when added to water. **D2881**

DISCUSSION—Emulsion synthetic fluids are blended with water in their end use.

endotoxin, *n*—a lipopolysaccharide derived from the outer membrane of Gram-negative bacteria. **E1497, E2144, E2657**

endotoxin unit (EU), *n*—a biological potency unit equivalent to the FDA Reference Standard Endotoxin (RSE). **E2144, E2657**

DISCUSSION—Currently EC-6 is equivalent to 0.1 ng 3D 1 EU.

exposure, *n*—contact with a chemical, biological, physical, or other agent over a specified period time. **D1356**

DISCUSSION—Exposure is expressed as the integral of the concentration (or intensity) of the agent at the boundary of the receptor over the time period of contact, that is, $E \sim = \sim \int C(t)\, dt$.

extractable mass, *n*—the material removed by the liquid of the sampling filter using a mixed polarity mixture as described in Test Method D7049. **E1972**

DISCUSSION—This mass is an approximation of the metalworking fluid portion of the workplace aerosol.

eye irritation, *n*—damage or inflammatory effect caused to the eye due to exposure to a chemical substance.

folliculitis, *n*—an inflammatory reaction in hair follicles. **E1497**

forming, *v*—process in which material is stamped, stretched, bent, or given a new shape without intentionally removing material.

fume, *n*—properly, the solid particles generated by condensation from the gaseous state, generally after volatilization from melted substances, and often accompanied by a chemical reaction such as oxidation. **D1356**

DISCUSSION—Fumes flocculate and sometimes coalesce. Popularly, the term is used in reference to any or all types of contaminant, and in many laws or regulations with the added qualification that the contaminant has some unwanted action.

functional additive, *n—in metalworking fluid*, a chemical substance formulated into a metalworking fluid to provide one or more specific performance properties not inherently provided by the basestock. **D2881**

DISCUSSION—Functional additives include but are not limited to: antifoaming agents, antimicrobial pesticides, buffers, corrosion inhibitors, coupling agents, emulsifiers, lubricity additives, and metal deactivators. The number and range of functional additives varies with the metalworking fluid formulation, and can range from a single additive to numerous additives in order to provide the performance properties specified by the fluid compounder.

fungicide, *n*—antimicrobial pesticide specifically or primarily effective against fungi. **E2169**

gram-negative bacteria, *n*—prokaryotic cells that have a complex cell-wall structure that stains characteristically when subjected to the differential Gram staining procedure. **E2657**

grinding, *v*—machining operation in which material is removed from the workpiece by a powered abrasive wheel, stone, belt, paste, sheet, compound, slurry, etc.

gundrilling (gunning), *v*—drilling process using a single-lip, self-guiding tool to produce deep, precise holes.

DISCUSSION—During gunning, high-pressure coolant is fed to the cutting area, usually through the gundrill's shank.

half-life ($T_{½}$), *n*—time required for concentration of a microbicide to diminish to one-half its original concentration.

honing, *v*—a low-velocity abrading process by which material removal is accomplished at lower cutting speeds than in grinding.

DISCUSSION—In honing, heat and pressure are minimized, resulting in excellent size and geometry control. The most common application of honing is internal cylindrical surfaces. The cutting action is obtained using abrasive sticks (aluminum oxide and silicon carbide) mounted on a metal mandrel.

impactor, *n*—a device for collecting airborne or emission particulate matter in which the air or gas being sampled is impacted or impinged against a surface. **D1356**

DISCUSSION—A cascade impactor is a type of impactor which employs several stages of impaction in series to collect successively smaller sizes of particles.

impingement, *n*—the act of bringing matter forcibly in contact. **D1356**

DISCUSSION—As used in air sampling, impingement refers to a process for the collection of particulate matter in which the gas being sampled is directed forcibly against a surface.

impinger, *n*—broadly, a sampling instrument employing impingement of the collection of particulate matter. **D1356**

inactive ingredient, *n*—component of antimicrobial pesticide that is not directly responsible for the pesticide's antimicrobial performance. **E2275**

DISCUSSION—Inactive ingredients may include, but are not limited to, solvents and chemicals that improve the pesticide's non-biocidal performance properties, such as miscibility and reactivity with non-target molecules in the treated material.

lethal dose, *n*—a concentration (usually mass of treatment agent per unit mass of test subject) at which treatment kills at least one of test subjects. **E2169**

DISCUSSION—The LD_{50} is the term used in toxicology defining the dose that kills fifty percent of the test population.

limulus amebocyte lysate (LAL) assay, *n*—a biological assay that detects endotoxin. **E2144**

limulus amebocyte lysate (LAL) assay, *n*—a biological assay dependent on a series of cascading enzyme reactions that occur when Limulus blood cell (amebocyte) lysate combines with endotoxin. **E2657**

Luciferase, *n*—a general term for a class of enzymes that catalyze bioluminescent reactions. **E2694**

Luciferin, *n*—a general term for a class of light-emitting biological pigments found in organisms capable of bioluminescence. **E2694**

luminometer, *n*—an instrument capable of measuring light emitted as a result of non-thermal excitation. **E2694**

lysis, *n*—refers to the death of a biological cell by breaking of the cellular membrane. **E2694**

metalforming, *v*—see *forming*.

metalforming fluid, *n*—any fluid in the subclass of metalworking fluids used for the purpose of drawing, rolling, stamping, or other metal-shaping process.

metal removal fluid (MRF), *n*—any fluid in the subclass of metalworking fluids used to cut, or otherwise take away material or piece of stock. **E2148**

DISCUSSION—Metal removal fluids include straight or neat oils (D2881) not intended for further dilution with water, and water-miscible soluble oils, semisynthetics, and synthetics, which are intended to be diluted with water before use. Metal removal fluids become contaminated during use in the workplace with a variety of workplace substances including, but not limited to, abrasive particles, tramp oils, cleaners, dirt, metal fines and shavings, dissolved metal and hard water salts, bacteria, fungi, microbiological decay products, and waste. These contaminants can cause changes in the lubricity and cooling ability of the metal removal fluid, as well as have the potential to adversely affect the health and welfare of employees in contact with the contaminated metal removal fluid. (E2148)

metal removal fluid aerosol, *n*—aerosol generated by operation of the machine tool itself, as well as from circulation and filtration systems associated with wet metal removal operations, and may include airborne contaminants of microbial origin. **E1972**

DISCUSSION—Metal removal aerosol does not include background aerosol in the workplace atmosphere, which may include suspended insoluble particulates.

metal removal process, *n*—a manufacturing process that removes metal during shaping of a part, including machining processes such as milling, drilling, turning, broaching, tapping and grinding processes, as well as honing and lapping, and other similar mechanical operations in which metal is removed to form a finished part. **E1497**

metalworking fluid (MWF), *n*—any fluid used for the purpose of cooling or treating metal surfaces during metal removal, metal forming, or surface protection or preservation.

microbicide, *n*—synonymous with antimicrobial pesticide. **E2169**

microscopic factor (MF), *n*—a calibrated conversion factor for calculating the Mycobacterium count per mL.

DISCUSSION—The average number of mycobacterium cells per one microscopic field (or oil field, OIF) is multiplied by the MF to give the concentration of mycobacterium per mL of sample. **E2564**

milling, *v*—machining operation in which metal or other material is removed by applying power to a rotating cutter.

DISCUSSION—Milling takes two general forms. In vertical milling, the cutting tool is mounted vertically on the spindle. In horizontal milling, the cutting tool is mounted horizontally, either directly on the spindle or on an arbor. Horizontal milling is further broken down into conventional milling, where the cutter rotates opposite the workpiece; and climb milling, where the cutter rotates in the direction of the feed.

minimum inhibitory concentration (MIC), *n*—lowest treatment dose that will prevent test population from growing, proliferating, or otherwise contributing to biodeterioration. **E2169, E2275**

mist, *n*—liquid, usually water in the form of particles suspended in the atmosphere at or near the surface of the earth; small water droplets floating or falling, approaching the form of rain and sometimes distinguished from fog as being more transparent or as having particles perceptibly moving downward. **D1356**

mutagenicity index (MI), *n*—the slope of the dose response curve for mutagenicity in the modified Ames test. **E1687**

DISCUSSION—MI is an index of relative mutagenic potency.

non-tuberculous Mycobacteria (NTM)—environmental mycobacteria, not associated with tuberculosis. **E2564**

odor, *n*—that property of a substance which affects the sense of smell; any smell; scent; perfume. **D1356**

odor threshold, *n*—the concentration of an odorous compound at which the physiological effect elicits a response 50 % of the time. **D1356**

oil immersion field (OIF), *n*—the circular area of a microscopic field visible in the eye piece of the microscope using oil immersion objective. **E2564**

personal sampler, *n*—a portable sampling instrument that is attached to a person to ascertain the concentration of specific constituents in the air in the person's breathing zone. **E2144**

polycyclic aromatics (PCA), *n*—for the purposes of this test method, PCA refers to fused-ring polycyclic aromatic compounds with three or more rings. **E1687**

DISCUSSION—Examples of this hydrocarbon series include phenanthrene (3), pyrene (4), benzopyrene (5), dibenzopyrene (6), and coronene (7). Heterocyclic polynuclear compounds are also included in this definition. Polycyclic aromatics are also referred to as polynuclear aromatics (PNA) and polycyclic aromatic hydrocarbons (PAH).

pyrogen-free (PF), *adj*—material(s) devoid of measurable endotoxin activity. **E2657**

rapidly growing mycobacteria (RGM), *n*—non-tuberculosis *Mycobacteria* that grow and produce visible colonies in four to seven days. **E2563**

reaming, *v*—a machining process that uses a multi-edge, fluted cutting tool to smooth, enlarge, or accurately size an existing hole.

relative light unit (RLU), *n*—an instrument-specific unit of measurement reflecting the number of photons emitted by the Luciferin-Luciferase driven hydrolysis of ATP to AMP plus pyrophosphate.

DISCUSSION—RLU is not an SI unit, however, RLU are proportional to ATP concentration. **E2694**

roll forming, *v*—a process for forming cylindrical or semicylindrical shapes from sheet or plate by feeding the work edgewise into the gap between a cluster of at least three relatively small diameter straight rolls.

DISCUSSION—The size of the gap between rolls, and its relationship to sheet thickness, determines the bend radius in the finished cylinder. Roll bending is also used to form solid bars, rods, heavy-wall tubes and special shapes into desired shapes.

sawing, *v*—machining operation in which a powered machine, usually equipped with a blade having milled or ground teeth, is used to part material (cutoff) or give it a new shape (contour bandsawing).

DISCUSSION—The four basic types of sawing operations are: (*1*) hacksawing: power or manual operation in which the blade moves back and forth through the work, cutting on one of the strokes; (*2*) cold or circular sawing: a rotating, circular, toothed blade parts the material; (*3*) bandsawing: a flexible, toothed blade rides on wheels under tension and is guided through the work; and (*4*) abrasive sawing: abrasive points attached to a fiber or metal backing part stock.

semi-synthetic fluid, *n*—a metalworking fluid that generally contains >20 % water and <50 % petroleum oil and functional additives.

DISCUSSION—Semi-synthetic fluids are blended with water in their end use and generally create micro-emulsions (average particle size <1.0 µm) when diluted with water. **D2881**

sensory irritation, *n*—discomfort or burning sensation of the eyes, nose, or throat, or cough caused by exposure to a chemical substance (sensory irritant).

skin corrosion, *n*—visible destruction of, or irreversible alterations in living tissue caused by chemical action at the site of contact. **E1302**

skin irritation, *n*—a reversible inflammatory effect on living tissue by a chemical reaction at the site of contact. **E1302**

skin sensitization, *n*—an allergic reaction in normal tissue after repeated exposure to a chemical.

DISCUSSION—Chemical sensitizers are materials that cause a substantial proportion of exposed individuals to become sensitized after repeated exposure.

solution synthetic fluid, *n*—a metalworking fluid formulation that contains no petroleum oil and forms in a single-phase, a true solution (no micelles) when mixed with water. **D2881**

DISCUSSION—Solution synthetic fluids are blended with water in their end use.

straight oil, *n—in metalworking fluids*, a metalworking fluid that contains petroleum oil, but essentially no water and is not emulsifiable.

DISCUSSION—Straight oils can contain functional additives. **D2881**

straight synthetic oil, *n*—a metalworking fluid formulation that contains no petroleum oil or water. **D2881**

DISCUSSION—Straight synthetic oil formulations typically prepared with renewable triglycerides, synthetic hydrocarbons, esters, or other oil-soluble basestocks; generally combined with oil-soluble additives that contain no water.

DISCUSSION—These formulations are not intended to be diluted nor emulsified with water in its end use.

synthetic fluid, *n*—a metalworking fluid that contains no oil and forms a true solution (no micelles) when mixed with water.

DISCUSSION—Classification D2881 categorizes synthetic fluids as non-petroleum oil containing solution synthetic fluids, emulsion synthetic fluids, or straight synthetic oils, depending on whether the finished product forms a true solution or emulsion with water, or is immiscible with water. For the purposes of this document, synthetic fluid is synonymous with solution synthetic fluid.

tapping, *v*—machining operation in which a tap with teeth on its periphery cuts internal threads in a pre-drilled hole having a smaller diameter than the tap diameter.

DISCUSSION—Threads are formed by a combined rotary and axial-relative motion between tap and workpiece.

tramp oil, *n*—oil and oil-soluble additives, sometimes insoluble, resulting from leaking hydraulic, spindle, slideway, or gear oil into the metalworking fluid. **E1497**

DISCUSSION—Tramp oils may contaminate the metalworking fluid with components that are emulsifiable but which are not parts of the metalworking fluid as formulated.

vapor, *n*—the gaseous phase of matter that normally exists in a liquid or solid state. **D1356**

viable microbial biomass, *n*—metabolically active (living) microorganisms. **E2694**

wet metalworking fluid environment, *n*—the workplace environment in which wet metalworking operations occur. **E1497**

5. Symbols, Abbreviations, and Acronyms

5.1 *AFB*—acid-fast bacteria

5.2 *a.i.*—active ingredient

5.3 *AMP*—adenosine monophosphate

5.4 *a.s.*—as supplied

5.5 *ATP*—adenosine triphosphate

5.6 *CFU*—colony forming unit

5.7 *DMC*—direct microscopic count

5.8 *EU*—endotoxin unit

5.9 *LAL*—Limulus amebocyte lysate

5.10 *MF*—microscopic field

5.11 *MI*—mutagenicity index

5.12 *MIC*—minimum inhibitory concentration

5.13 *MRF*—metal removal fluid

5.14 *MWF*—metalworking fluid

5.15 *NTM*—non-tuberculosis mycobacteria

5.16 *PCA*—polycyclic aromatic

5.17 *PF*—pyrogen free

5.18 *RGM*—rapidly growing mycobacteria

5.19 *TWA*—time-weighted average