



Standard Terminology for Metalworking Fluids and Operations¹

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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 and health practices and determine the applicability of regulatory limitations prior to use.*

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 Metal Removal 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
- 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 Test Method for Enumeration of Non-Tuberculosis *Mycobacteria* in Aqueous Metalworking Fluids by Plate Count Method
- E2564 Test Method for Enumeration of *Mycobacteria* in Metalworking Fluids by Direct Microscopic Counting (DMC) Method
- E2657 Test Method 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:³

- 29 CFR 1910.1200 Occupational Safety and Health Standards, Hazard Communication
- 40 CFR 156 Labeling Requirements for Pesticides and Devices

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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 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.

3. Significance and Use

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

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

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

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 breath. **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 irritant 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, oil (frequently referred to as “soluble oil”), *n*—a metalworking fluid that generally contains >30 % petroleum, synthetic, or vegetable oil plus emulsifiers, corrosion inhibitors and other additives. 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. <https://standards.iteh.ai/3f23c0-1cf0-464b-acad-7638bc0932e5/astm-e2523-13>

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, $E = \int C(t) dt$.

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 ($T_{1/2}$), *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—