

GLOSSARY OF TERMS—Metalworking Fluids

Alkaline	Pertaining to having a pH greater than 7.0; sometimes called caustic
Ammonia	A gas (NH ₃) comprised of nitrogen (N) and hydrogen (H) that has solubility in water ; can be formed when specific bacteria biodegrade certain amines into ammonia and water; the ammonia can be released into the air creating worker complaints
Bacteria	Micro-organisms that live in the air, soil, and water that can infect a metalworking fluid; the infection creates problems as the micro-organisms consume various product components; bacteria are typically less than 1 micron in size
Bactericide	A Federally controlled substance that predominately kills bacteria
Biocide	A Federally controlled substance that kills both bacteria & fungi
Biofilm	A gelatinous mass of bacteria and/or fungi that deposits a film on a solid surface
Boundary Lubricant	A polar molecule that aligns itself with the metal surface to create a “cushion” of lubrication; esters, fatty acids and fats are common boundary lubricants
CFU/ml	Acronym for colony forming unit/ml; a measure of microbiological growth
COC	Abbreviation for Cleveland Open Cup; laboratory device used to determine the flash point of a fluid above 212°F (100°C)
Chelate	A chemical process that binds specific metals to the chelating agent; a common chelating agent is EDTA (ethylene diamine tetraacetic acid) used to bind calcium and magnesium ions in solutions to “soften” water
Chloride	A negative ion (anion) of chlorine typically found in most water supplies; prone to creating corrosion in higher concentrations in aqueous applications
Chlorine	A compound of chlorine atoms; typically used to provide extreme pressure lubrication in the form of a chlorinated compound like chlorinated paraffin
Coolant	Fluid used to remove heat from an application; in metalworking, coolants are the water-soluble fluids like soluble oils, semi-synthetics and solutions
Corrosion	The chemical process where a metal is oxidized to a different state making the metal more susceptible to rust; the metal substrate shows signs of pitting to some degree
Cutting Fluid	Description for a metal removal fluid used in a machining or grinding application; this covers straight oils and all ranges of water-soluble fluids
DI	Abbreviation for deionized, as in DI water; DI water has no hardness or conductivity because it contains no ions
Dipslide	Any type of plastic paddle that holds a surface of agar that is dipped into a used metalworking fluid to determine the presence of micro-organisms; usually one side of the paddle detects bacteria while the other detects fungi
EP	Abbreviation for extreme pressure; EP additives are forms of sulfur, chlorine and phosphorus that are activated under extreme pressure situations where heat is created
Emulsion	Two fluids that are immiscible (i.e. not mixable) that are intimately dispersed in one another with an “oil” particle size that is greater than 0.10 microns
Endpoint	The completion of a titration; usually marked by reaching a specific pH (potentiometric) or color change with an indicator (colorimetric); see titration & indicator
Ester	An organic compound that is created by a chemical reaction between an alcohol and an acid; an ester is polar and provides boundary lubrication; esters can be man made or natural



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Exothermic	A chemical reaction, which creates and gives off heat; strong acids and bases will create exothermic reactions
Falex “Block on Ring” Tester	Laboratory test method used to assess and compare lubrication qualities of metalworking fluids; a ring of metal is rotated while a block of metal is applied to the outer diameter of the rotating ring; a scar is produced on the block and is measured as part of the analysis
Falex Four Ball Tester	Laboratory test method used to assess and compare lubrication qualities of metalworking fluids; four balls are configured so that one ball, under a load, bears down on three balls producing a scar; the size of the scar is measured as part of the analysis
Falex Pin & V-Block Tester	Laboratory test method used to assess and compare lubrication qualities of metalworking fluids; a vertical pin rotates against two V-shaped blocks while pressure is applied to the blocks; load and torque are measured as part of the analysis
Fine Settling/ Handling	The capability of a metalworking fluid to disperse and permit metal fines to fall out of solution and settle to the bottom
Filtration	A physical separation of solids from liquid; positive filtration utilizes filter media (paper, cartridges, belt, etc.) or other physical means (magnet, conveyor, etc.); passive filtration is achieved without media (centrifuge, cyclone, etc.).
Foam	Emulsified air; the result of excess turbulence or detergency with a metalworking fluid
Fungi	A micro-organism that is found in the soil and air and tends to live around the metalworking fluid; fungi consists of both yeast and mold and is larger than bacteria (about 2-10 microns); usually seen in splash areas rather than in the metalworking fluid itself
Fungicide	A Federally controlled substance that predominantly kills fungi
HLB	Abbreviation for hydrophile-lipophile balance; a numeric value (0-20) assigned to emulsifiers and surfactants (see hydrophilic & lipophilic for more details) to provide information regarding the emulsification properties of the chemical
Hardness	Related to water quality and is made up of the calcium (Ca) and magnesium (Mg) content expressed as PPM of calcium carbonate (CaCO ₃); 17.8 PPM of hardness is equivalent to one grain of hardness
Hydrodynamic	The simplest form of lubrication; a simple liquid film that provides a temporary cushion between two moving surfaces
Hydrophilic	Having a water-loving characteristic or quality; hydrophilic compounds are more water soluble
Indicator	Specific fluid used in very small quantities in a colorimetric titration that creates a color change when the endpoint is reached
Invert	As in invert emulsion; this would be a water in oil emulsion (W/O) that is created when water is added to product concentrate instead of the other way around
Lipophilic	Having an oil-loving characteristic or quality; lipophilic compounds are more oil soluble
Lubricant	Any fluid that reduces friction between moving surfaces
Micelle	Technical name for the grouping of surfactants; often used when describing the emulsification of the oil droplets in an emulsion
Micron	A measurement of length designated by the Greek letter mu (μ); one micron is equal to one micrometer (μm), 0.001 millimeters or 0.000039 inches
O/W	Oil in water emulsion; see emulsion
PAH	Polycyclic aromatic hydrocarbon; this is the multi-ringed hydrocarbons found in base oils during the refining process; some are known to be carcinogens; PAHs are eliminated via solvent extraction or severe hydro-treatment



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PMCC	Pensky-Martens Closed Cup; laboratory device used to determine the flash point of fluids which flash below 212° F (100°C)
PNA	Poly-nuclear aromatic; see PAH
PPB	Parts per billion; one PPB is equivalent to one milliliter in 251,000 gallons
PPM	Parts per million; one PPM is equivalent to one milliliter in 251 gallons
PPTH	Parts per thousand
Particle Size (emulsion)	Size of oil droplets, or that which is being emulsified, in water usually measured in microns; this “particle” is not a hard particle, like a grain of sand, but is porous and can be disrupted or broken down
Particle Size (solid)	Size of dirt and debris when extracted from dirty fluid via some form of positive filtration; often used in filter patch tests to describe the weight of dirt filtered at a specific micron size
Plate Count	The microbiological method employed to assess growth of microorganisms in a used metalworking fluid; must be conducted in a laboratory under sterile conditions; individual colonies are counted (see CFU/ml) after the plates (petri dishes) are incubated
pH	The logarithmic scale for determining acidity (less than 7.0) or alkalinity (greater than 7.0) of a watercontaining fluid with 7.0 being neutral
Polymer	A chemical compound containing a repeating unit of a particular base unit (i.e. monomer); many solution synthetics utilize this technology for lubrication; while there are some natural polymers, most of this technology is a synthetic, man-made chemical
Premix	The action of mixing a water-soluble concentrate with water in order to create a stable mixture under controlled conditions prior to going into the main clean tank
R & R	Abbreviation for Repeatability and Reproducibility used to asses variability within a testing process; if Analyst 1 & Analyst 2 test the same set of samples, repeatability is the variability of results for Analyst 1 or Analyst 2; reproducibility is the variability between Analyst 1 and
RO	Abbreviation for reverse osmosis; RO is used to treat water to remove ions and is often used in conjunction with and after water has been passed through deionization (DI)
Rancidity	The biodegradation of coolants by microorganisms growing in the fluid typically acknowledged by strong obnoxious odors
Refractometer	An optical device used to determine the concentration of aqueous mixtures
SUS	Abbreviation for Saybolt Universal Seconds; a measure of viscosity
Semi-synthetic	Metalworking fluid that contains some oil but has a small enough fluid particle size to be considered a micro-emulsion (less than 1.0 microns); a semi-synthetic is typically translucent in appearance when diluted in water
Soil load	A measurement of finely dissolved dirt and particles in a metalworking fluid; this can be determined via centrifuge or via filtration of a fixed volume of fluid
Soluble oil	Metalworking fluid that contains oil and emulsifiers and creates an emulsion when added to water; a soluble oil is typically milky in appearance when diluted in water
Solution	A mixture in which the fluid is immediately and completely soluble in water; a solution has no fluid particle size, contains no oil and is clear in dilution; sometimes called solution synthetic
Stain	A chemical process similar to corrosion that produces slight imperfections of the metal surface; can typically be chemically removed without extreme damage to the metal substrate



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Straight oil	Metalworking fluid that is used as received; typically contains oil with a variety of additives
Sulfate	A negative ion (anion) typically found in most water supplies; prone to creating corrosion in higher concentrations
Surfactant	An acronym for surface active agent; surfactants provide wetting and detergency
TCC	Abbreviation for Tag Closed Cup; a laboratory device used to determine the flash point of fluids which flash below 212°F (100°C)
TDS	Abbreviation for total dissolved solids; a measurement of ions (dissolved chemicals) in solution usually expressed as microSiemens or micromhos
Titration	A simple acid-base reaction conducted to determine an alkalinity or acidity of a fluid; the method is employed to determine concentration of an unknown
Tramp oil	A liquid contaminant that gets into a metalworking fluid and creates problems; sources are hydraulic oils, spindle oils, way lubricants, rail lubricants and gear lubricants; incoming parts can carry in corrosion preventives or cutting oils as tramp oil; these fluids can cover the surface of the metalworking fluid, cutting off the air supply, permitting bacteria to grow

GLOSSARY OF TERMS—Metalworking Fluid Test Methods

Acid Number or Acidity	Measures the total acidity of a product to confirm the correct amount of fatty acids or the lack of acidbearing compounds in a straight oil. Free acids can also be assessed in metalworking fluid.
Acid Split	Measures the total amount of active materials that can be split from an emulsion. For most fluids, these are the nonwater soluble materials like oil, ester and fatty acids. This can be used as a concentration control method but the influx of tramp oil will impede accurate readings.
Alkalinity	Measures the total amount of alkaline materials. Different methods permit for total alkalinity versus reserve alkalinity. Alkalinity is important relative to maintaining biostability and corrosion protection. Alkalinity and pH, while related, are not the same. Low alkalinity does not always mean low pH and visa versa.
Appearance	How the product appears under different temperatures or conditions.
Bioresistance	Standard 8-week ASTM test to assess a fluid's resistance to bacteria and fungi, separately. Additional testing can be conducted to examine the two organisms together.
Cloud Point	Measures the temperature at which a certain chemical will no longer be soluble and it will come out of solution and create a cloudy appearance.
Cobalt Leaching	For customers that utilize a lot of carbide tooling, cobalt is the binder that holds the carbide together. This method assesses the degradation of the carbide by monitoring cobalt content.
Conductivity	Ability of a liquid to transfer electricity; for most water-soluble products, ions in the water impact the conductivity. For some emulsions, high levels of conductivity can actually disrupt the emulsion and create a split condition.
COD/BOD	Chemical Oxygen Demand is the measurement of all chemicals in the water which can be oxidized. The Biological Oxygen Demand measures oxygen uptake by bacteria during the oxidation of organic matter. Both tests are often run on the water phase after waste treatment to determine the efficiency of the waste treatment process.
Cold Test	Temperature at which a particular fluid may solidify or create a gel; result is used to assess a pass or fail.
Color	Like appearance, this is strictly a visual examination to make sure the product appears as it should. There are color standards for comparison.
Corrosion	There are several methods used for ferrous corrosion testing; there are a few types of cast iron chip tests as well as tests that use steel panels; there is also a stack stain test generally used for corrosion preventives.
Density	Required for the SDS; it is the mass/volume calculation; it is also reported as lbs/gal.
Dirt Content	Test used to assess used fluids with regard to how much "soil" they contain. The soil can be fines and other debris that can be filtered at a specific micron level to confirm how much "dirt" is present. This is used for comparative testing.



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Elastomer Compatibility	This ASTM procedure examines elastomers after their exposure to a fluid under controlled conditions; the changes examined are hardness and size.
Elemental Analysis	Many times specific elements have to be acknowledged as being present or absent in a product. Typical elements assessed are boron, calcium, chlorine, magnesium, phosphorus, sodium, silicon and sulfur.
Emulsion Stability	Just about every watersoluble fluid will get exposed to the customer's water to confirm that the dilution (solution or emulsion) is stable; sometimes the testing is performed under dynamic conditions with specific contaminants.
Flash Point & Fire Point	Flash point is required for the SDS and some customers want to see the fire point as well. There are different methods depending upon the boiling point of the fluid which is driven by the water content.
Foam	There are several methods to examine foam, but the best methods generally use some type of recirculation. Many customers use a blender foam test but blenders run at 17,000 rpms which is not representative of most fluid pumps. The foam test should examine the foam build and foam breaking.
Lubrication	There are many test methods for this parameter, including Falex Pin and V-Block, Falex Four Ball, Twist Compression Test, Tapping Torque Test, Coefficient of Friction Test and others; the test that most closely replicates the lubrication regime of the customer process should be used. Lubrication testing using an actual CNC machine with the same metal and tool used in the process can give an excellent approximation of the effectiveness of the product. A standard product or the product currently in use should be analyzed at the same time as the test product.
Microbiological	For fluids that must maintain long sump lives, resistance to bacterial and fungal growth is important. Two methods are used to determine the presence of growth: plate counts (auger in a petri dish) and dip slides. Both methods report results a Colony Forming Units per milliliter (CFU/ml). Dip slides have become popular because of the "ease of use" in the field. Proper storage of unused slides is important for accurate assessments.
Moisture	Some fluids are sensitive as to the presence of water. Two methods are distillation and the Karl Fisher (KF) titrator. The distillation is used for larger quantities of water while the KF titrator is used for trace amounts.
Neat Product Stability	Similar to emulsion stability in that the neat product is assessed for stability at four basic temperatures: 0, 40, 75 and 120°F. The testing should include the most severe conditions under which the fluid may be stored. Some products are unstable when frozen or heated too high.
Non-ferrous Staining	Similar to corrosion testing but is reserved for non-ferrous alloys such as cast aluminum, wrought aluminum, copper, brass and bronze. Appropriate metal samples are submerged in fluid and the metal surface below the fluid level, at the fluid level and above the fluid level (vapor phase) are examined for stain.
Odor/Smell	Another requirement for the SDS. Helps identify the fluid but can be somewhat subjective.
pH (Neat and Diluted)	Another requirement for the SDS. The diluted pH is also important relative to staining, corrosion and is particularly critical to maintaining bioresistance.
Pounds per Gallon	(see Density)
Pour Point	Temperature at which a fluid will no longer pour. Useful for products that might have a tendency to freeze but not split.
Refractometer	While many end users prefer to use the hand held refractometer for concentration control, this method is not very accurate and can be misleading.
Residue Characteristics	This is similar to emulsion characteristics in that the dried fluid should not be tacky or sticky and should be resolvable in its own dilution or water.
Saponification	This method is referred to as "SAP" and is used for fluids that contain fats or esters. Fat and esters can be saponified and then titrated to determine the amount.
Stack Stain	This method attempts to duplicate what happens when steel surfaces are sandwiched together with a liquid between them. Often times this method is run at elevated temperatures to hasten the results.



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Surface Tension	Caused by the cohesive forces between liquid molecules that tend to restrain the liquid from flowing or wetting a surface. The surface tension value is useful to predict a cleaner's ability to wet out soils on a surface and may also impact lubrication or foam.
Tramp Oil Rejection	This method is used to assess the amount of oil a fluid will reject after being contaminated with that oil. The level of rejection is also dependent upon the level of shear used to mix the oil into the fluid. Tramp oil determination can become complex when multiple sources of tramp oil are present.
Viscosity	The resistance to flow by a liquid. Generally this is used on straight oils or product concentrates.
Volatile Organic Compound (VOC)	Determines how much of the fluid will "evaporate" into the air based on the temperature of the test. The EPA method uses 110°C for the evaporation test, but some customers prefer temperatures closer to the operating conditions of the application.



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