



Standard Classification for Metalworking Fluids and Related Materials¹

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1. Scope

1.1 This classification covers and is designed to standardize and consolidate the terminology, nomenclature, and classification of metalworking fluids and related materials.

1.2 Metalworking fluids includes both metal removal and forming fluids. These are the coolants and lubricants associated with both types of processes.

1.3 This classification implies no evaluation of product quality or suitability for a given metalworking operation.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Terminology

2.1 Definitions of Terms Specific to This Standard:

2.1.1 *amorphous*, *adj*—possessing neither a lattice nor crystalline arrangement of atoms.

2.1.2 *crystalline*, *adj*—possessing a lattice or crystalline structure; that is, a definite arrangement or pattern of atoms in space.

2.1.3 *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.

2.1.4 *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.

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

2.1.5.1 *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.

2.1.6 *micelle*, *n*—a colloidal aggregate of surfactant molecules that occurs at a well-defined concentration.

2.1.7 *petroleum oil*, *n*—a naturally occurring hydrocarbon mix that was initially formed under pressure in the earth's crust and is liquid at room temperature.

2.1.8 *straight oil*, *n*—*in metalworking fluids*, an oil, petroleum or synthetic, which essentially contains no water and is neither emulsifiable nor miscible in water.

2.1.9 *synthetic fluid*, *n*—a non-petroleum liquid that possesses lubricating properties. It includes both man-made and naturally occurring liquids.

2.1.10 *vitreous*, *adj*—having the appearance and properties of a glass; that is, a hard, amorphous, brittle structure.

3. Significance and Use

3.1 Metalworking may be divided into two general types of processes, metal deformation (such as rolling) and metal removal (such as grinding or cutting). This classification lists the various types of fluid and non-fluid materials used to directly provide cooling and lubrication in both types of metalworking processes. It is intended for use by those in metalworking or related industries who want to differentiate these materials. It is up to the user of this classification to determine the relevance of the items listed with respect to their application.

4. Basis of Classification

4.1 Metalworking fluids and related materials are divided into three broad categories: petroleum oil containing fluids, non-petroleum fluids, and solid and semi-solid materials. Under each of these broad categories, the types of fluids and materials related to each category are listed with a description.

4.1.1 Petroleum Oil-Containing Fluids:

4.1.1.1 *Emulsifiable Oil (frequently referred to as "Soluble Oil")*:

(1) Generally contains >30 % oil before dilution with water.

(2) Contains emulsifiers and other functional additives.

(3) Generally creates a macro-emulsion (average size >1.0 μm) when diluted with water.

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(4) Blended with water in its end use.

4.1.1.2 *Semi-synthetic Fluid:*

(1) Generally contains > 20% water and < 50% petroleum-oil.

(2) Contains functional additives.

(3) Generally creates a micro-emulsion (average particle size < 1.0 µm) when diluted in water.

(4) Blended with water in its end use.

4.1.1.3 *Straight Oil:*

(1) Contains petroleum oil but essentially no water.

(2) Not emulsifiable.

(3) Can contain functional additives.

4.1.2 *Synthetic Non-Petroleum Fluids:*

4.1.2.1 *Solution Synthetic Fluid:*

(1) Contains no petroleum oil.

(2) Contains functional additives.

(3) Forms in a single-phase a true solution (no micelles) when mixed with water.

(4) Blended with water in its end use.

4.1.2.2 *Emulsion Synthetic Fluid:*

(1) Prepared from vegetable oil, esters or other synthetic basestocks.

(2) Contains emulsifiers and other functional additives but no petroleum oil.

(3) Produces an emulsion when added to water.

(4) Blended with water in its end use.

4.1.2.3 *Straight Synthetic Oil:*

(1) Contains no petroleum oil nor water.

(2) Formulations typically prepared with renewable triglycerides, synthetic hydrocarbons, esters or other oil-soluble basestocks; generally combined with oil-soluble additives that contain no water.

(3) Not intended to be diluted nor emulsified with water in its end use.

4.1.3 *Solid Lubricants:*

4.1.3.1 *Powders:*

(1) Crystalline.

(2) Polymeric.

(3) Amorphous.

4.1.3.2 *Vitreous Materials:*

(1) Borates.

(2) Glasses.

(3) Phosphates.

4.1.3.3 *Greases and Pastes:*

(1) Greases.

(2) Dispersions or solutions in non-aqueous fluids.

(3) Dispersions or solutions in water.

4.1.3.4 *Solid Films:*

(1) Particle bonded.

(2) Resin bonded.

(3) Vitreous bonded.

5. Keywords

5.1 coolants; greases; metal forming fluids; metal removal fluids; metalworking fluids; pastes; semi-synthetic fluids; solid lubricants; soluble oils

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