



# Standard Classification for Metal Working Fluids and Related Materials<sup>1</sup>

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## 1. Scope

1.1 This classification of metal working fluids and related materials is designed to standardize and consolidate the terminology, nomenclature, and classification of these products.

1.2 Metal working 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.

## 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 of an emulsion, and thus stabilizes one in the other.

2.1.4 *emulsion, n*—a relatively stable mixture of two immiscible liquids held in suspension by small amounts of emulsifiers.

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

2.1.6 *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.

2.1.7 *straight oil, n*—an oil, petroleum or synthetic, that essentially contains no water and is not emulsifiable nor miscible in water.

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

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

<sup>1</sup> This classification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.L0.04 on Metal Deformation Fluids and Lubricants.

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## 3. Significance and Use

3.1 Metal working may be divided into two general types of processes, metal deformation and metal removal or cutting. This classification lists the various types of fluid and non-fluid materials used to directly cool and lubricate 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 their application.

## 4. Basis of Classification

4.1 Metal working 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 Soluble Oil:

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

(2) Contains emulsifiers, corrosion inhibitors, and other additives

(3) Generally creates a macro-emulsion (average size >1.0  $\mu\text{m}$ ) when diluted with water

(4) Blended with water in its end use

#### 4.1.1.2 Semi-synthetic Oil:

(1) Generally contains  $\leq$ 30 % oil before dilution with water

(2) Contains emulsifiers, corrosion inhibitors, and other additives

(3) Generally creates a micro-emulsion (average particle size <1.0  $\mu\text{m}$ ) 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) May contain corrosion inhibitors, lubricity agents, and other additives

### 4.1.2 Synthetic Non-Petroleum Fluids:

#### 4.1.2.1 Solution Synthetic Fluid:

(1) Contains no petroleum oil

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

- (3) Blended with water in its end use
- 4.1.2.2 *Emulsion Synthetic Fluid*:
  - (1) Contains emulsifiers but no petroleum oil
  - (2) Produces an emulsion when added to water
  - (3) Blended with water in its end use
- 4.1.2.3 *Straight Synthetic Oil*:
  - (1) Contains no petroleum oil nor water
  - (2) 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; metal working fluids; pastes; semi-synthetic fluids; solid lubricants; soluble oils

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