

Glossary of Technical Terms

Acidity:

In lubricant terminology acidity is found by an industry standard test method (ASTM D664), which can measure acid and alkalinity, denoted by: Total Acid Number (TAN); Strong Acid Number (SAN); and Total Base Number (TBN). Most analyses for TBN however use other methods.

Under normal circumstances TAN denotes the presence of weak acids, usually as the result of oil degradation – oxidation, (organic). SAN denotes the presence of acid forming products usually associated with the presence of sulphur compounds from partially burnt combustions products (inorganic). TBN measures the reserve alkalinity present in oil, and is mainly related to internal combustion engine lubricants, e.g. Locomotive, Marine and Power Generation Diesel and Natural Gas engines. The alkalinity to combat any sulphur based by-products finding their way into the oil.

TBN and SAN cannot normally exist together.

Boundary Lubrication:

A state of lubrication characterized by partial contact between two metal surfaces, and partial separation of the surfaces by a fluid film of lubricant. When metal-to-metal contact occurs severe wear can take place.

Coefficient of Friction (CoF, μ):

Defines the frictional characteristics of certain materials, or combination of materials.

More accurately called the Coefficient of Kinetic Friction and is calculated from $\mu = F/L$.

(Where F = frictional force and L = the force of the load acting normally to the plane of motion, or potential motion).

Lower Figure = Less Friction.

Combustible:

As defined by OSHA: any liquid having a flash point at or above 100°F (37.8°C), but below 200°F (93.3°C), except any mixture having components with flashpoints of 200°F (93.3°C), or higher, the total volume of which make up 99% or more of the total volume of the mixture. See Flammable.

Corrosion:

Destruction of a metal by chemical or electrochemical reaction with its environment.

dN Factor:

Traditional but still useful calculation for considering high speed limits of ball bearings and lubricants.

dN Factor = bearing bore (diameter) [in millimetres] x Ball bearing speed [in rpm].

Accepted rule of thumb is dN Factor > 300,000 indicates materials & lubricants used may need careful consideration be given to their high speed characteristics

Demulsibility:

The ability of water and oil to separate from each other. In the more universally used test method equal volumes of oil and water, at the same temperature, are agitated for 5 minutes and then allowed to settle, with oil separation recorded at minute intervals up to 15 mins, and then at 5 minute intervals to 60 minutes. Total separation is considered to be complete when 37ml oil has separated, (3ml emulsion cuff allowable)

Other tests use differing percentages of oil and water, and temperatures, depending on the type of oil being tested, can be carried out. Here the volume of free water separated from the emulsion, and volume of the emulsion cuff, is the main parameters measured. Demulsibility may be reduced however by the presence of oxidation products, or other contamination that promotes emulsification.

Demulsifier:

An additive that promotes oil-water separation in lubricants that are exposed to water or steam.

Drop Point:

The temperature at which a drop of the grease falls from an orifice of the test apparatus under conditions of the prescribed test method. (This test should be considered as having limited bearing upon service performance.)

Maximum continuous operating temperatures normally will be in the range of 10°C (50 °F) to 90°C (200 °F) below the drop point, depending upon the temperature quality of the grease.

Elasto-Hydrodynamic Lubrication:

Similar to Hydrodynamic Lubrication but very thin and requires the lubricated surfaces to deform at the contact interface.

This is a lubrication condition in which the friction and film thickness between the bodies in relative motion are determined by the elastic properties of the bodies, in combination with the viscous properties of the lubricant at the prevailing pressure, temperature and rate of shear.

Emulsion:

A mechanical mixture of two mutually insoluble liquids, such as oil and water. Highly refined mineral oils are inherently resistant to emulsification.

Extreme Pressure (EP):

It is, now, generally accepted that the main role of EP lubricants is to improve the Boundary Layer Lubrication. Tests show that under extreme pressure micro-welds are formed between the asperities of metals when in moving contact. Relative movement is achieved by breaking these micro-welds – thus increasing the friction between the surfaces that are in relative motion.

Film Strength:

The ability of a lubricant film to withstand the effects of load, speed, and temperature without breaking down or rupturing.

Fire Point:

The lowest temperature at which released vapors from a liquid surface will burn continuously for five seconds minimum, under specified conditions.

Flammable:

As defined by OSHA: any liquid having a flash point below 100°F (37.8°C.), except any mixture having components with flash points of 100°F (37.8°C.) or higher, the total of which make up 99% or more of the total volume of the mixture. Flammable liquids shall be known as Class I liquids. A liquid that is not flammable is called non-flammable. Inflammable = Flammable. See combustible

Flash Point:

Is the minimum temperature of a petroleum product, or other combustible fluid, at which vapor is produced at a rate sufficient to yield a combustible mixture. This is usually considered to be the lowest temperature at which the air vapor mixture will ‘flash’ in the presence of an ignition source (small flame).

Fluid Friction:

Friction between the molecules of a gas or liquid in motion, expressed as shear stress. Unlike solid friction, fluid friction varies with speed and area...

Fretting:

Fretting (derived from the term 'fretting corrosion') covers the wear phenomena occurring between two surfaces having small amplitude oscillatory relative motion. Small amplitude vibration between parts in elastic contact (such as ball bearings, cams, gears and stick/slip regions) occurs at the surface and results in the removal of finely divided particles. After they are formed, the fine particles are usually oxidized, giving the appearance of corrosion, which led to the term 'fretting corrosion' although corrosion is not part of the basic mechanism. Fretting wear has been shown in laboratory studies to decrease with improved lubrication.

Friction:

Friction is the resistance to motion offered by a surface as a result of its contact with another surface or substance. Sliding (kinetic) friction occurs between two solid bodies, while fluid friction occurs between the molecules of the fluid in motion.

Sliding friction is measured in units of the resistance force while fluid friction is measured in terms of **shear stress**. Both types can be wasteful of power and energy. Sliding friction also results in **wear**.

In general, **lubrication** is the substitution of low fluid friction in place of high sliding friction and resulting wear.

Galling:

Descriptive term relating to gears. These are dragged, roughened surfaces due to lubrication failure. More severe than scoring or scuffing.

Hydrodynamic Lubrication:

When a viscous film completely separates moving surfaces. It is affected solely by the 'pumping' action developed by the sliding of one surface over another in contact with lubricating oil. Adhesion to the moving surface draws the oil into a high-pressure wedge shape area between the surfaces, and viscosity retards the tendency to squeeze the oil out.

Immiscible:

Incapable of being mixed without separation of phases. Water and petroleum oil are immiscible under most conditions, although they can be made miscible with the addition of an emulsifier.

Last Non Seizure Load:

Highest Load at which full Hydrodynamic Lubrication exists before Elasto-Hydrodynamic Lubrication occurs.

Last Seizure Load:

Highest load at which Elasto-Hydrodynamic Lubrication exists before Boundary Lubrication occurs.

Load Wear Index:

This is a calculated figure used to indicate the ability of the test lubricant to reduce wear of the contact surfaces and is, probably, the most significant result from the 4 Ball Test. Higher figures indicate better protection, less wear.

Lubrication:

Control of friction and wear by the introduction of a friction reducing film between moving surfaces in contact. The film may be fluid, solid or plastic.

Lubricity

A term used to describe the ability of a lubricant to reduce friction between rubbing surfaces. There are no generally accepted test methods available to evaluate this property. Lubricity is important mostly in conditions of boundary lubrication and probably represents some relationship to the ability of the oil to wet the bearing surfaces and to resist being rubbed off. Lubricity has no known direct relationship to oil viscosity. Often also referred to as 'oiliness'.

Miscible/Compatibility:

Capable of being mixed in any concentration without separation of phases. Almost all mineral oil and Poly Alpha Olefin (PAO) based lubricants are miscible when mixed together. Products such as Poly-Alkylene Glycol (PAG); Phosphate Esters and Polyolesters are not miscible with mineral based lubricants.

NLGI Consistency:

Simplified system established by the National Lubricating Grease Institute (NLGI) for rating the consistency of grease.

Oil Separation:

Usually noted when opening a container after storage. Is due to some thickeners (soaps) not being fully soluble in the oil base, but they should have some attraction for the oil. Greases with a large proportion of thickener, the attraction is strong.

The 'loosely' held oil is part of the lubrication mechanism in grease lubrication, and a bearing lubricated with a dry (non-bleeding) grease is apt to be noisy in service.

Operating Temperature:

The operating temperature range within which the lubricant can work effectively.

Oxidation Stability:

The ability of a lubricant to resist natural degradation upon contact with oxygen.

Penetration:

An arbitrary measure of consistency (hardness) of a lubricating grease, based on the penetration of a sample of lubricating grease immediately after it has been brought to 25°C (77°F) and then subjected to 60 stokes in a standard grease worker. The softer the grease the higher the penetration number.

Pour Point:

The Pour point is 3°C (5°F) above the point at which a chilled lubricant shows no movement at the surface for 5 seconds when inclined. This measurement is especially important for oils used in cold conditions.

Rust Inhibitors:

Additives that form a chemical reaction with the metal which forms a tenacious water proof film and prevents water from adhering to the metal causing rusting. Rust, of course, is extremely abrasive and can cause excessive wear.

Scar:

The part of the spherical surface that is 'flattened' during the 4 Ball Test.

In the low load tests it is a result of wear and deformation due to the load and is sometimes considered to be an indicator of wear protection. In the higher load tests, the deformation becomes the major contributing factor. Hence scar size alone should not be considered an accurate indicator of wear protection – the Load Wear Index is a much more meaningful indicator.

Scuffing:

Scuffing is the abnormal wear that occurs when seizure, micro-welding and subsequent tearing apart of the moving surfaces. Scuffing is known to be a problem when there is evidence of metal transfer between the metal surfaces in contact with each other.

Shear:

Shearing: is the slipping or sliding of one part of a substance relative to an adjacent part.

Shear Rate: The rate of slip within a substance engaging in flow

Shear Stability: The ability of a lubricating grease to resist changes in consistency.

Shear Stress: The force per unit area tending to cause shearing in a substance. In fluids, the ratio of the shear stress to the shear rate is the viscosity of the substance.

The Shear Stress of a petroleum oil or other Newtonian fluid at a given temperature varies directly with shear rate (velocity).

Spalling:

Descriptive term relating to gears. Refers to large areas of broken-out metal due to metal fatigue caused by heavy surface loading.

Sulfated Ash:

The percentage of additive mass remaining after burning unused lubricating oil, then treating the residue with sulfuric acid, then burning this to ash. It gives an indication of the presence of detergent/dispersant additives and their percentages.

Viscosity:

Is the measure of resistance to flow (“flowability”) of a fluid. It is usually expressed in terms of time required for a standard quantity of the fluid at a certain temperature to flow through a standard orifice. More specifically, it is the property of a lubricant to develop and maintain a certain amount of shearing stress dependent on flow, and then to offer continued resistance to flow. Thicker lubricants generally have a higher viscosity. **Absolute Viscosity** is a term used interchangeably with **Viscosity** (to distinguish it from **Kinematic Viscosity**). **Absolute Viscosity** is defined as the Poise, and is the shear stress required to move one layer of fluid along another, over a total layer thickness of 1cm, at a shear rate of 1cm/sec. The unit Poise is ‘dyne-sec/cm². The Centipoise is 1/100th of a Poise and is the unit of absolute viscosity.

Absolute Viscosity measurements are independent of density and are directly related to resistance to flow.

Absolute Viscosity is used in applications where shear is a problem and is often coupled with Brookfield Viscosity method under low temperature conditions. The principle lubricant group involved being transmission and gear fluids.

Kinematic Viscosity: is the property measured when a fixed volume of the oil flows through a capillary tube under the force of gravity. The test temperatures are 40°C and 100°C. The time taken, in seconds, is noted and is then converted by multiplying by the viscometer constant to give the viscosity. The units of Kinematic Viscosity are the Stoke or Centistoke (cSt). Kinematic Viscosity in Centistokes (cSt) is the usual method used with regard to lubricating oils.

Viscosity Index (VI):

VI is an empirical number indicating the rate of change in viscosity of an oil within a given temperature range. Low **VI** signifies a relatively large change in viscosity with temperature. Conversely high **VI** oils show a relatively low change in viscosity with temperature.

VI cannot be used to measure any other quality in an oil.

Water Resistance:

The ability of a lubricating grease to withstand the addition of water to the lubrication system without adverse effects and is generally made up of four components:

Washout Resistance: The ability of a lubricating grease to resist being removed from a bearing when operating fully, or partially, submerged in water. (ASTM D1264)

Water Absorption: The characteristics of the grease when water is added to the lubrication system. May be measured by any of several suitable tests in which the lubricating grease may react, in any of 3 ways:

- **Water Soluble** where the grease absorbs the water and de-gels to a semi-fluid consistency
- **Water Absorbent** where the grease absorbs relatively large quantities of water with little or no change in consistency, and without leaving free water as a separate phase.
- **Water Resistant:** where the grease does not absorb more than a small amount of water and does not change appreciably in consistency, and leaves the added water as a second phase

Water Corrosion Resistance: The ability of a lubricating grease to prevent corrosion of surfaces when water is present in the lubrication system. May be measured either statically by any of a number of standard tests, or dynamically by actual operation of bearings with water added to the lubricant reservoir. (ASTM D1743)

Water Spray Resistance: The ability of a grease to resist displacement from a surface by the impact of water spray (ASTM D4049).

Wear:

The removal of materials from surfaces in relative motion. There are basically three types of wear:

- **Abrasive** – removal of material in relative motion by a cutting or abrasive action of a hard particle (usually a contaminant)
- **Adhesive** – removal of materials from surfaces in relative motion as a result of surface contact. Galling and scuffing are extreme cases.
- **Corrosive** – removal of materials by chemical actions.
- **Fatigue** – often associated with mechanical problems, including assembly faults, poor alignment, imbalance etc.

Wear is often associated with metal particles being found in the lubricant.

Weld Load:

The point at which all lubrication protection ceases.

Fastex Surface Modifier Technology offers improved Boundary Lubrication by giving improved EP characteristics of a system. The tangible result of this improvement is reduced Wear. Also, unlike traditional EP improvers, the proprietary technology also reduces Frictional effects.