Lubrication Lexicon

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QUESTION

I must confess I sometimes find myself a bit dazed when discussing lubrication issues with either staff or vendors. The terminology seems to be all over the lot, with some terms having double meanings. Can you help cut through the confusion?

Expert answer provided by Robert Errichello, Geartech, Inc. *(geartech@mt.net)*

The following "primer" on tribology nomenclature should help to clear the fog. It is an article by Douglas Godfrey that was published in the STLE magazine, *Lubrication Engineering*. And while it was first published in 1989, I believe in this case what was true then, holds true 25 years later.

TRIBOLOGY NOMENCLATURE

Discontinue use of "Extreme Pressure (EP);"Use "Antiscuff"

EP lubricants generally contain chemically active additives that coat or react with metal surfaces to form films that prevent scuffing. However, the term "EP" is not appropriate; some explain the term by saying it really means extreme temperature. Occasionally we see the ridiculous and self-contradictory term "mild, extreme pressure." High contact pressures are not always necessary to cause scuffing, nor is scuffing expected to occur under high contact pressures if metallurgy and lubricant choices are ideal. On the other hand, extreme pressures — such as 300,000 psi — exist in elastohydrodynamic lubrication where no controlling chemical reaction occurs. Antiscuff is my recommendation, which is based on function, rather than a particular mechanism or condition. Thus the definition could be simple: "An antiscuff lubricant is one that inhibits scuffing." This definition will help reduce the frequent confusion about the difference in EP and antiwear lubricants. The term parallels antiwear, which is a lubricant that reduces wear.

Discontinue "Film Strength"

Years ago I used the term "film strength," but now I recommend against using it. A lubricant film may be "strong," but the meaning is not clear. Modern research shows that the important parameter of an oil film is its thickness in relation to the roughnesses of the rolling or sliding surfaces – i.e., the lambda factor. Also, the important properties of an antiscuff or antiwear solid surface film are physical; e.g., melting point, thickness, and hardness in relation to the metal underneath, shear strength, and tenacity.

Discontinue use of "Oiliness" and "Friction Modifier;" Use "Lubricity"

The term oiliness is extremely vague and does not even suggest the intended meaning of low friction or lubricity. Medicinal white oil is oily but a very poor boundary lubricant. So if one means that the oil has natural or synthetic friction-reducing properties, the term lubricity should be used, which could be defined as that property of a lubricant that reduces friction. A lubricant with fatty acid additives has lubricity. The term "friction modifier" means literally that the oil decreases or increases friction. Of course a decrease or reduction is what is usually meant, so let's say what we mean and use "friction reducer."

Discontinue use of "Saybolt Universal Seconds (SUS);" Use Centistoke, cSt

SUS, or SSU, or "seconds" is a viscosity value from a particular apparatus, under particular conditions, and is obsolete and not an internationally acceptable expression of viscosity. The centistoke is a fundamental viscosity for kinematic viscosity. Centipoise cP is the accepted unit for dynamic viscosity. The International Standard Organization's Viscosity Grades, ISO VG, may be used. The number corresponds to kinematic viscosity in centistoke at 40°C.

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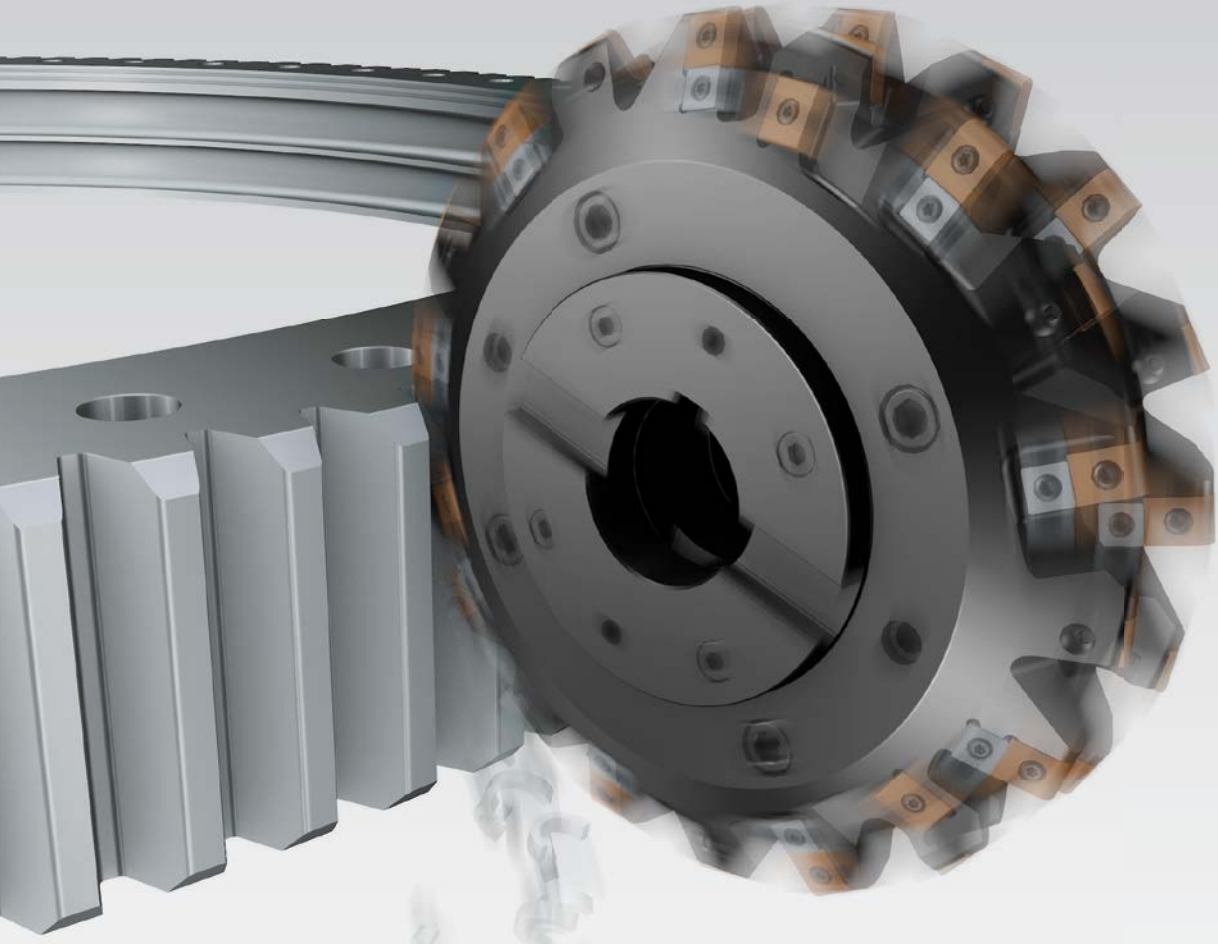

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Discontinue "Thick" or "Thin" and "Heavy" or "Light;" Use High or Low Viscosity

Thick and thin, although very commonly used, are dimensional measurements, so, their use for oil film thickness is proper. However, it is imprecise, and careless for tribologists to use them to describe lubricant viscosity. Heavy and light indicate weight, mass, or relative density. Since lubricant viscosities are essentially independent of density, the use of heavy and light for viscosity are misleading and incorrect. Molecular weight and boiling range are related to lubricant viscosity. Similarly, we should not use "weight" following SAE for oil grade. The proper terminology is "SAE Grade," not, for example "30 weight."

Discontinue "Dry" Lubricant;" Use Solid Lubricant

"Dry" suggests the absence of water and should not be used for solid lubricants. Graphite and many solid polymers are dependent upon a little oil or water for effective lubrication. In contrast, molybdenum disulfide works best in a dry environment or in a vacuum. In tribology, let's reserve "dry" to mean the absence or very low concentrations of water.

Discontinue "Anti-Friction" Bearings; Use Rolling Element Bearings

Once in a while an author uses the old-fashioned term "anti-friction" for rolling element bearings. The term "anti-friction" originated because the start-up friction of rolling element bearings was lower than for sliding bearings. But currently this difference is less important, due to hydrostatic bearings, low shear strength surface films, and lubricity additives for sliding bearings. The amount of pure sliding that occurs in rolling element bearings could cause high start-up friction under high loads. Sealed, grease-lubricated, rolling element bearings can have considerable friction or resistance to rotation.

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Discontinue "Mechanical Wear/ Chemical Wear"

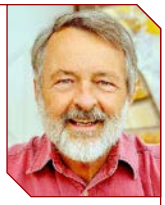
"Mechanical Wear" and "Chemical Wear" are often used as the only two wear mechanisms; but, in my opinion, these are much too general and interrelated to be useful. For example, wear apparently due to mechanical conditions, (such as high load), can actually be a result of chemical factors (such as the rate of oxide film formation). Conversely, wear involving chemical reaction (such as corrosive wear), can be highly dependent upon physical or mechanical properties of the corrosion product. I recommend being specific on the wear mechanism involved.

Discontinue "Scoring;" Use Scuffing

In the U.S. gear industry, scoring is often used interchangeably with scuffing. Scuffing is used exclusively elsewhere in the world. The word scoring suggests scratching by a hard sharp tool, which is abrasion. Scoring, for scuffing, causes confusion, especially outside the U.S., and should not be used. The term scuffing should be used to indicate the metal transfer, tearing, and local welding involved.

The above article by Douglas Godfrey *was published in* STLE *magazine* Lubrication Engineering, *December 1989, pp. 750-751. It is reproduced here with minor editorial changes, including the following*:

- Antiscuff is used instead of Anti-scuff
- Antiwear is used instead of Anti-wear
- Rolling Element Bearings is used instead of Roller Bearings



Robert L. Errichello possesses over 40 years of industrial and classroom experience; heads up his own gear consulting firm—GEARTECH; and developed his proprietary GEARTECH software. Bob has been a consultant to the gear industry for the past 35 years and to over 40 wind turbine manufacturers, purchasers, operators and researchers. He has taught courses in material science, fracture mechanics, vibration and machine design at San Francisco State University and the University of California, Berkeley. He's presented numerous seminars to professional societies, technical schools and the gear, bearing, and lubrication industries, and his AGMA Gear Failure Analysis seminar is sold out every session. In his "spare" time Bob is a member of several AGMA committees, including the AGMA Gear Rating Committee, AGMA Nomenclature Committee, AGMA/AWEA Wind Turbine Committee, ASM International, ASME Power Transmission and Gearing Committee, STLE, NREL GRC, and the Montana Society of Engineers. A prolific author, Bob has published over 70 articles on design, analysis, and application of gears, and is the author of three widely-used computer programs for the design and analysis of gears. He is a longtime technical editor for *GEAR TECHNOLOGY* and STLE Tribology Transactions. He is recipient of the AGMA TDEC Award, the AGMA E.P. Connell Award, the AGMA Lifetime Achievement Award, the STLE Wilbur Deutch Memorial Award, and the AWEA Technical Achievement Award.

Table 1 Tribology nomenclature

Preferred term	Discontinued term	Application
Antiscuff	Extreme pressure (EP)	Antiscuff additive Antiscuff lubricant
None	Film strength	None
Lubricity	Oiliness Friction modifier	Lubricity additive
Centistoke (cSt)	Saybolt universal seconds SUS or SSU	Kinematic viscosity (the official SI unit for kinematic viscosity is m^2/s. Industry uses the unit centistoke (cSt) or mm^2/s).
Solid lubricant	Dry lubricant	Coatings to reduce friction and wear such as graphite, molybdenum disulfide, or soft metals.
High viscosity Low viscosity	Thick lubricant Thin lubricant Heavy lubricant Light lubricant	ISO viscosity grade
Rolling element bearing	Anti-friction bearing	Ball or roller bearings
Adhesive wear Abrasive wear Hertzian fatigue	Mechanical wear	Failure modes involving primarily mechanical mechanisms
Corrosion Fretting corrosion	Chemical wear	Failure modes involving primarily chemical or electrochemical reactions