Basic Concepts of Friction and Lubrication

Lubrication can be a daunting obstacle to someone unfamiliar with its basic concepts. Even someone with experience can be confused by the technology of current machinery combine with the multitude of lubrications available on the market today. Reviewing a few of the basic principles of lubrication can make it easier to see why proper lubrication is necessary in every application.

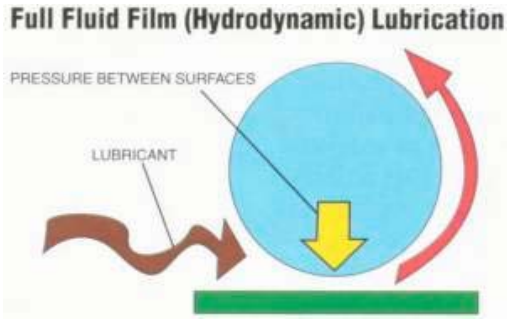
Webster defines friction as the "rubbing of one body against another," and as "resistance to relative motion between two bodies in contact." Friction can be beneficial. As we overcome this resistance to motion between two objects in contact, heat is generated. This heat is what warms our hands or starts a fire. Friction is also the principle behind the braking systems we find on our automobiles. In fact, once we were able to get a car moving there would be nothing to stop it without friction except the effects of gravity or other objects.

However, friction can also be our enemy. The heat generated as the result of friction can cause damage. Because contact is required to generate friction, wear in the areas of contact can occur. This can lead to material failures, overheating and the formation of wear deposits

Although there are many ways to reduce friction, the most common way is through the use of a fluid or a semi-fluid material. The key characteristic of such materials is that they are not readily compressible. Fluid and semi-fluid materials allow us to minimize component contact or eliminate contact altogether. These fluids are commonly referred to as **lubricants.**

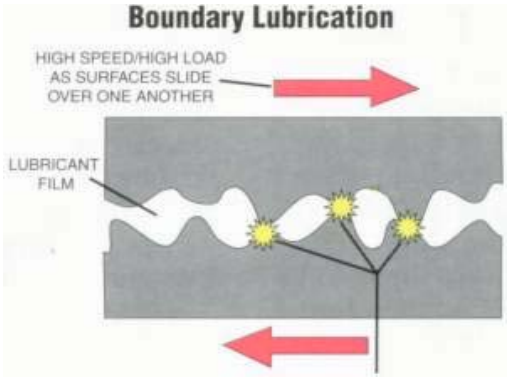
TYPES OF LUBRICATION

There are **three** types of lubrication or lubrication situations that can exists between two surfaces separated by a lubricant. Whether or not these situations occur is dependent upon the ability of the lubricant to provide adequate protection to the moving surfaces

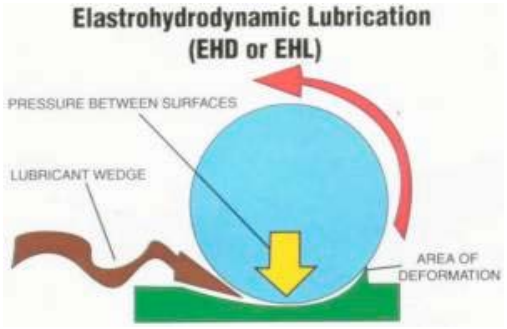


When a fluid lubricant is present between two rolling and/or sliding surfaces, a thicker pressurized film can be generated by the movement of the surfaces (at their respective velocities). The non-compressible nature of this film separates the surfaces and prevents any metal-to-metal contact. The condition in which surfaces are completely separated by a continuous film of lubricating fluid is commonly referred to as **Hydrodynamic** or **Full Fluid Film Lubrication**

Although hydrodynamic lubrication is the ideal lubrication scenario, in many situations it cannot be maintained. Hydrodynamic lubrication is limited by the lubricant's viscosity, the rotation speed or RPM and by component loading. An increase in speed or viscosity increases oil film thickness. An increase in load decreases oil film thickness



Boundary Lubrication is a condition in which the lubricant film becomes too thin to provide total surface separation. This may be due to excessive loading, low speeds or a change in the fluid's characteristics. In such a case, contact between surface asperities (or peaks and valleys) occurs. Friction reduction and wear protection is then provided via chemical compounds rather than through properties of the lubricating fluid.



The third type lubrication situation is known as **Elastohydrodynamic Lubrication** (EHD or EHL). This situation occurs as pressure or load increases to a level where the viscosity of the lubricant provides a higher shear strength than the metal surface that it supports. As a result, the metal surfaces deform elastically in preference to the highly pressurized lubricant. This increases the contact area and decreases the effectiveness of the lubricant.
To minimize friction, an effective lubricant should be able to handle the pressures and speeds of the surfaces it will separate.