

# Lubrication and Lubricants

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How to Cite This Article

Lubricants reduce friction and wear between the surfaces of machines and keep them running smoothly. Lubricants are important for the proper operation of engines, bicycle chains, and nearly every other machine with moving parts.

Any surface, no matter how smooth it may appear, looks very uneven and bumpy under a microscope. Whenever two surfaces move against each other, there is a force that works against that movement. That force is friction.

Sometimes friction is very useful and, in fact, necessary. There must be friction between an automobile's tires and the road. Otherwise, the tires would just spin and the automobile would not move, as often happens on icy or other slippery surfaces.

There are many places, however, where friction is a nuisance. If there is too much friction in a machine, extra power is needed to make it run. This makes running the machine very expensive. In some machines friction can produce enough heat to cause the parts to be welded together.

When an oil is used as a lubricant, friction is reduced by separating the two surfaces with a thin oil film so that they do not touch. When the two surfaces are moved, the fluid between them acts like a deck of cards, moving in layers. The resistance of the fluid layers to movement is called fluid friction, or **viscosity**. Liquids of high viscosity are thick and do not flow as easily as low-viscosity liquids.

There are four kinds of lubricants: gases, liquids, semisolids, and solids.

## Gaseous Lubricants

A gas such as air or nitrogen can be pumped between the surfaces of bearings to separate them, thus reducing friction and wear. The principle is much the same as on an air hockey table, where a puck slides over a layer of air jets. One high-technology application of gaseous lubricants is in the disk drive of a desktop computer, where bytes of information are stored on a rotating disk. As the disk rotates, the bytes sweep past a recording head, which transmits the information to the computer. To prevent friction and wear in the disk drive, these surfaces must be lubricated, but because of the degree of cleanliness required, oils cannot be used. Instead, air acts as the lubricant, separating the disk and recording head by only 15 to 50 nanometers. (A nanometer is one-billionth of a meter.)

## Liquid Lubricants

Petroleum oils, by far the most common liquid lubricants, are made in many different viscosities. Oils are often graded according to their viscosity using a scale established by the Society of Automotive Engineers (SAE). To reduce friction as much as possible, it is necessary to use oil of the lowest viscosity possible. But where pressure between the parts of a machine is great, a thin (low-viscosity) oil would be squeezed out, leaving the parts without lubrication. Here it is necessary to use thicker (higher viscosity) oil. Sometimes synthetic materials such as silicons and chemical groups called esters and synthetic hydrocarbons are used for special lubricating purposes.

Lubricating oils tend to thin when they are heated and thicken when they are cold. However, additives can help keep oils at the same viscosity when temperatures change.

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